

**EAST LAKE FIRE & RESCUE
BACK INJURY REDUCTION PROGRAM**

EXECUTIVE DEVELOPMENT

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ABSTRACT

According to the 1997 International Association of Fire Fighters (IAFF) Annual Death and Injury Survey report: sprains and strains were the leading on-duty injuries, 43.9 %, with the highest percentage of injuries to the back, 44.7 %. The problem is that the largest single category of injuries, 46 %, at East Lake Fire & Rescue was back injuries due to sprains and strains. The purpose of this Applied Research Project was to research and formulate a method of implementation of a back injury reduction program for East Lake Fire & Rescue.

Action research methodology was used in this Applied Research Project.

The research questions to be answered were:

1. Why is the back so prone to injury?
2. What are the components of a back injury reduction program for firefighters?
3. Should the use of back belts be a component of a back injury reduction program?

The procedures included a Literature Review of current Fire Service technical journals, reports and books, as well as other related sources. Data from past logs and summary of Occupational Injuries were reviewed. Contact was made with the YMCA to investigate implementation of the *Healthy Back Program*. A copy of *Fire and Emergency Medical Services Ergonomics: A Guide for Understanding and Implementing an Ergonomics Program in Your Department* was obtained from the U.S. Fire Administration. A survey of the members of East Lake Fire & Rescue was administered to determine the value of continued use of back belts by the department as part of their protective equipment.

The results of the research determined that back injuries can be reduced by education on

proper lifting techniques and body mechanics. The components of a back injury reduction program are: exercise to improve muscle strength, endurance and flexibility, as well as implementation of an ergonomics program. Fire departments should not rely on back belts as part of their back injury reduction program, but should begin to undertake preventative measures to reduce injuries.

Three recommendations were made as a result of this research:

1. Education and instruction of the members of ELF&R about the causes of back pain, proper posture, and correct body mechanics and lifting techniques.

2. Implementation of the YMCA's *Healthy Back Program*, in addition to the *Fire and Emergency Medical Services Ergonomics: A guide for Understanding and Implementing an Ergonomics Program in Your Department*.

3. The back belts that are part of the protective equipment of ELF&R will be removed from the safety equipment inventory.

A draft of the Injury Reduction Program for East Lake Fire & Rescue can be found in Appendix A.

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INTRODUCTION

Preventing back injuries is a major workplace safety challenge. Firefighters place great stress on the low back by lifting and carrying heavy or awkward loads and by performing arduous tasks. Wearing Self Contained Breathing Apparatus (SCBA), firefighters may have to walk, run, climb, crawl, or jump-often while dragging, pushing or lifting objects. Fatigue may increase chances of injury. Back strain or injury is common due to all of the demands placed on a firefighters body. In many cases, however, back injuries can be prevented (Lowe, 1997, p.8).

In February, 1999, members of the Safety Committee of East Lake Fire and Rescue (ELF&R) reviewed the 1998 log of Occupational Injuries that was sent to the Florida Department of Labor and Employment Security. This study brought attention to the fact that East Lake Fire and Rescue had a 46 % occurrence of back injuries, which is higher than the national percentage of back injuries for firefighters.

According to the International Association of Fire Fighters (IAFF) *1997 Annual Death and Injury Survey* report: sprains and strains were the leading on-duty injuries, 43.9 %, with the highest percentage of injuries to the back, 44.7 % (p. 11). The problem is that the largest single category of injuries, 46 %, at East Lake Fire & Rescue was back injuries due to sprains and strains. The purpose of this Applied Research Project was to research and formulate a method of implementation of a back injury reduction program for East Lake Fire & Rescue.

Action research methodology was used in this Applied Research Project.

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BACKGROUND AND SIGNIFICANCE

Back pain is one of the most pervasive medical problems in our society. About 80 % of Americans will experience at least one incident of severe back pain in their lives. For about 20% of them that pain will become chronic, interfering with work. According to the Bureau of Labor Statistics, more than one million workers suffer back injuries each year, and back injuries account for one of every five workplace injuries or illnesses (Occupational Safety and Health Administration, 1993, p. 1).

According to the National Fire Incident Reporting System (NFIRS), back injuries are a particularly important problem for firefighters and rescue workers. Nancy L. Schwartz, Fire Analyst of the National Fire Protection Association, provided this researcher with the report, *The Patterns of Fire Fighter injuries, 1987-1988*, the last report by the NFIRS to collect data by part of the body injured. According to this report, the major types of injuries received by firefighters responding to, returning from, or operating at fire incidents, were strains and sprains occurring most frequently 36.8% to the trunk area (Karter, 1991, p.11).

East Lake Fire & Rescue is a full service department providing First Responder Advanced Life Support and fire protection to the community. The twenty-eight members of the staff are young, conscientious and fitness minded. A Comprehensive Wellness Program was implemented in October of 1998. The fitness component includes a mandatory structured program at the Y.M.C.A. requiring that members work out one and half hours per shift with a personalized exercise prescription supervised by

the fitness specialists of the Y.M.C.A. Since this program was already in place, contact was made with Lauran Winship the senior fitness specialist, to consider expanding the program to include the Y's *Healthy Back Program*.

This researcher completed a review of the data collected between 1992 and 1998 on occupational injuries for ELF&R (Appendix D). Results of this investigation revealed that back injury was the highest category of injuries within the department. Part of this researcher's responsibility as training officer for the department was to formulate and implement a back injury reduction program. This program was formatted in an Applied Research Project to satisfy the Applied Research Project requirement associated with the Executive Fire Officer Program at the National Fire Academy. As Fire Officers, part of our duty is to properly manage our department's resources, which includes money and personnel. If we allow injuries to occur when they could have been avoided, we are not fulfilling our obligation as Executive Fire Officers.

The research project relates to the National Fire Academy's Course *Executive Development* Unit 8, Ethics. "Recognize the executive's responsibility for establishing, communicating, and enforcing ethical standards for the organization. Any issues with the potential to harm or to benefit others has ethical implications" (National Fire Academy, 1999, p.8-5).

LITERATURE REVIEW

The purpose of this literature review was to establish a foundation for this project. This includes studying the concepts of back injury reduction, and implementation of a program to reduce back injuries due to sprains and strains. Sprains and strains are some of the most common back problems. "We

describe muscles as strained, and joints and ligaments as strained” (IMPACCUSA, 1995, p. 2).

Back Injury Etiology

The back is a complex structure with a very demanding job to do. It must stabilize the body in posture, and the extremities during all motions, work and play, and therefore is never at rest.

Back muscles are susceptible to injuries primarily because they work so diligently with very little time off. Even when you're just standing still, the postural muscles are keeping you stable...they labor hardest of all, naturally, when you're active, controlling every move your back makes, from opening a cabinet to throwing a softball (Maharam, 1996, p. 64).

The back is one of the most neglected parts of the body in terms of maintaining fitness, strength and flexibility. Most people take their back for granted, until it starts to give them pain. "The majority of back problems build gradually and progressively through the accumulated effects of poor posture, faulty biomechanics, stress, loss of flexibility, and a lack of physical conditioning" (Pearson, Hayford, Royer, 1995, p. 163).

Back pain can be divided into five basic causes: mechanical factors, disc injury, muscle dysfunction, injury due to poor body mechanics or trauma, and acquired conditions.

1. Mechanical Factors: Stresses to the back include excessive body weight, poor posture, especially sitting in a slumped position for long periods of time, and inadequate levels of strength and flexibility. "These factors, plus weak abdominal muscles, create an excessive forward curvature of the lower spine, called [lordosis] or sway back. This condition causes strain and chronic pain in the lower back due to the muscle imbalance created by weak abdominal and tight back muscles” (Pearson, Hayford, Royer, 1995, p. 161).

2. Disc Injury: Degeneration of the vertebral discs is associated with the aging process. "Aging causes the spinal column to lose fluid and supporting back muscles to lose some of their tone" (Pearson, Hayford, Royer, 1995, p.161). "Many experts are convinced that most back problems, even minor ones, are related to disc deterioration, which is an evolutionary process rather than an acute injury" (Donajkowski, 1993, p. 22). Working in a physically demanding occupation, like firefighting, exacerbates the condition. "Medical studies suggest that one or more of the discs of a 35-year-old male in a physically demanding occupation over 10 years will have degenerated to some degree" (Kanner, 1995, p. 28).

3. Muscle Dysfunction: Muscle imbalance is created when the repetitive nature of physically demanding jobs promotes exceptional strength in certain muscles, while others remain undeveloped. "Tight muscles tug on the spine, potentially throwing the vertebrae out of alignment. The result: pain from the vertebrae, and stiffness from the tight tissue" (Maharam, 1996, p. 64). Muscle weakness results from atrophy of muscles due to lack of use. "When unused muscles are subject to unusual or sudden movement, a strain or tear may result that could cause the back to lose vital support" (Pearson, Hayford, Royer, 1995, p.162).

Stress is another cause of muscle dysfunction. "Although stress is not a direct cause of low back pain, stress provoked tension may induce muscles to tighten up. The resulting strain on the muscles that support the back can result in pain, stiffness, and even muscle spasms" (Pearson, Hayford, Royer, 1995, p.162).

4. Injury due to poor body mechanics or trauma: Lifting and moving heavy objects with poor body mechanics, especially twisting movement, causes strains and sprains of the back. "In the work

environment, people who have weak back muscles-particularly those whose activities require repetitive bending, twisting, or turning-suffer a significantly higher rate of back injury” (Kandel, Sudderth, 1996, p. 65). Functions such as rolling hose, picking up ladders or patients with poor body mechanics eventually cause back injuries. “Forward bending with a straight back and straight knees is one of the leading causes of lower back pain” (Pearson, Hayford, Royer, 1995, p. 162). Injuries to the back from motor vehicle accidents, falls, and other traumatic events are very painful and particularly difficult to heal.

5. Acquired Conditions: Lifestyles are becoming less active with the convenience of modern daily life. Less physical activity is causing joints to become stiff and immobile simply from under use. Joint problems in the vertebral column may also contribute to back pain. “Arthritis and the vertebral fractures that accompany osteoporosis are also causes of back pain. Even though these conditions result naturally through the aging process, they are promoted through a sedentary lifestyle characterized by inadequate levels of physical fitness” (Pearson, Hayford, Royer, 1995, p. 162).

Physical Fitness

Individuals that have a high level of physical fitness have lower incidence of back injuries. In a study of strength and fitness and subsequent back injuries in firefighters, Cady, et al. (1979) investigated whether high levels of physical fitness had a protective effect against injury. They measured five physical fitness variables: (1) endurance work, (2) total isometric strength, (3) spine flexibility, (4) diastolic blood pressure, and (5) heart rate, two minutes after exercise on a stationary bike. The results of their investigation demonstrated "that the most fit

individuals (contrasted with the least fit individuals) had fewer subsequent back injuries" (p.271).

In a follow-up study of Los Angeles County Firefighters, Cady, et al. (1985) tested physical work capacity (PWC), job-related strength performance, and spine flexibility of 998 firefighters who had been given exercise prescriptions and health promotion counseling as part of a physical fitness program. The resultant changes in levels of physical fitness observed were a slight improvement in spinal flexibility, a 16% increase in PWC, decreased number of disabling injuries, and a 25% reduction in Worker's Compensation costs.

Firefighters who are in better shape or have better aerobic conditioning have a reduced risk of low back injury. When your heart and lungs are strong from regular aerobic exercise, your muscles will get oxygen more easily. The muscle cells themselves undergo chemical changes with regular exercise that allow them to use oxygen more efficiently. This makes you fit; you can do more work with less effort. Your muscles, including your back muscles, will not fatigue as easily or as quickly, and injuries will be reduced (Lowe, 1997, p. 21).

Exercise Program

A healthy back is needed for all physical activities. The demands of firefighting require above average strength. "Several studies and job analysis have shown that the weight of equipment used by a single firefighter on the job is in excess of 100 lbs" (International Association of Fire Fighters, 1997 p. 55).

Exercise has many benefits, including maintaining a healthy back. "Developing and implementing a personal fitness program is encouraged to improve strength, muscular endurance and flexibility in the muscles and joints that support and align the spinal column" (LeCuyer, 1994, p. 40).

Strengthening the back muscles should be an important goal of any exercise program.

“Exercise prevents a significant source of acute and chronic back pain: weak back muscles. Without exercise strong muscles become weak and already weak muscles become weaker” (Kandel, Sudderth, 1996, p. 63).

The spine receives aid from large muscle groups that attach to the various levels of the spine, helping to stabilize it. These muscles, known as the paraspinal musculature, extend from the base of the skull to the sacrum. In the past, most doctors had no idea of the great importance of these muscles in maintaining a healthy spine. In fact, any successful fitness program of the low back really must address the strengthening of this musculature (Kandel, Sudderth, 1996, p. 27).

Increasing muscular endurance is another important goal of a good exercise program. When muscles are fit, they have good endurance, “...you can do more work with less effort. Your muscles, including your back muscles, will not fatigue as easily or as quickly, and injuries will be reduced” (Lowe, 1997, p. 21). “Compromised endurance appears to be involved in many injuries that occur during submaximal tasks, (e.g., picking up a pencil)...studies available suggest that endurance has a much greater prophylactic value than strength” (McGill, 1998, p. 759).

Strength and endurance of the abdominal muscles are also important factors in fitness.

“Abdominal muscle endurance is necessary to stabilize the torso and support the lower back during exertion. Weak abdominal muscles may contribute to low back pain and low back injury”

(International Association of Fire Fighters 1997, p.57). “We are beginning to recognize the need for individuals to achieve sufficient stability with abdominal wall muscle co-contraction...in upright postures,

and probably higher when bending over” (McGill, 1998, p. 759).

Good flexibility is important for everyone engaged in dynamic activity, but particularly critical for those whose jobs that require lifting, reaching, climbing and other tasks where their bodies bend and move appendages beyond normal ranges. "Some studies suggest poor flexibility, especially a lack of flexibility in the low back and hamstrings, is associated with an increased rate of injury" (O'Connor, 1996, p.22).

Hilyer, et al. (1990) studied the effect of flexibility training on the incidence and severity of joint injuries of 469 firefighters. Participants were divided into two groups, 251 experimentals and 218 controls. Exercise leaders were trained in a series of flexibility exercises for the lower back, hamstrings, shoulder muscles, and members of the experimental group were required to perform the designated flexibility exercises for 30 minutes each duty day. At the end of the study, "...the data indicate that injuries in the experimental group were less costly in lost time" (p. 636) and were assumed to be less severe, thus providing evidence that a flexibility intervention can reduce the severity of musculoskeletal injuries.

Ergonomics

“The word ergonomics is derived from the Greek words ‘ergon’ (work), and ‘nomos’ (law). In the United States, the term human factor engineering is often used” (Weerdmeester, Dul, 1994, p. 1). It takes into account the physical and psychological capabilities of humans and tries to design the workplace so as to avoid unsafe, unhealthy, and uncomfortable situations.

There are two types of ergonomic controls, administrative and engineering. “Administrative controls are used to minimize exposure to stressors and require supervisory monitoring to insure

compliance. Engineering controls are used to modify the workplace, tools or job design” (LeCuyer, 1994, p. 34).

Many injuries are a result of poor ergonomics. In a recent ranking, ergonomics related problems captured a number of the top places on the most pressing occupational disease and injury categories. Musculoskeletal injuries, traumatic injuries and deaths, cardiovascular diseases, and hearing losses were cited among the top ten categories (Alexander, Fabrycky, & Mize, 1986, p. 125).

“Injuries have had a devastating impact on private industry. To minimize the effects of injuries, private organizations have implemented ergonomics programs” (Kowahl, 1999, p. 5). According to Mallory’s Applied Research Project, *Ergonomics Within the Fire Service*, “there are no documented cases or history of an ergonomics program being implemented within the fire service” (Mallory, 1996, p. iii). In his study, Mallory compared the *1994 Death and Injury Survey* of Firefighters with the above mentioned categories of occupational disease and injury, and found that approximately 89% of all reported firefighter injuries are related to ergonomics (p. 5).

“Though there is a technical side to ergonomics, much of it is common sense” (Bradford, 1995, p. 27). According to LeCuyer, Health and Safety Coordinator for the Aurora, Colorado Fire Department, ergonomics modification of the workplace will help reduce injury risks for all firefighters in the current workforce. The study of ergonomics and safety is now sophisticated enough to have a significant effect on the prevention and cure of the most prevalent worker injuries. The best approach is an effective prevention program. Proper workplace ergonomics supplemented by a sound fitness program can play a key role in an injury-prevention program (LeCuyer, 1994, p. 41).

Back Belts

Back belts, also called "back supports" or "abdominal belts," are currently worn by workers in numerous industries, including grocery store clerks, airline baggage handlers, and warehouse workers. Back belts were initially used in medical settings. "These belts, termed [orthoses,] resemble the corsets worn by women in the nineteenth century and are typically used to provide additional back support during rehabilitation of injuries" (National Institute of Occupational Safety and Health, 1994, p. 1).

While there are more than 70 types of industrial back belts, the typical abdominal support used in workplaces today is a lightweight, elastic belt worn around the lower back, sometimes held in place with suspenders. The purpose of back belts "is to reduce wear and tear on the lower back when exposed to the harmful effects associated with material handling tasks" (Hilgen, 1992, p.40). A back support is essentially a splint used to reduce or prevent motion. "By preventing movement, the support may reduce injury risk" (Lund & Rambo, 1994, p. 33). "The mechanism by which this occurs is thought to be that the support raises the intra-abdominal pressure, which provides stability to the back and reduces pain" (Perry, 1992, p. 679).

Unfortunately, there is insufficient evidence to prove the effectiveness of back belts in reducing injuries. "The back belt does not increase the ability to lift and can not overcome muscle inadequacy, to which 90% of all back pain is attributed" (LeCuyer, 1994, p. 40). Wearing a back belt may give the worker a false sense of security in unsafely lifting. "There is some research showing that workers believe they can lift more when wearing a back belt. If workers falsely believe they are protected, they may subject themselves to even greater risks by lifting more weight than they would have without a belt" (National Institute of Occupational Safety and Health, 1994, p. 5).

In May 1994, NIOSH working group said "...it was [unproven] that back belts lessen the risk of back injuries among healthy workers. It said it could not recommend their use and did not consider them personal protective equipment" (LaBar, 1996, p. 33). In fact, they may cause more harm than good. In May 1995, the state OSHA program in Minnesota issued a statement: "It warned that more than a dozen medical conditions, ranging from hypertension to breathing problems, could be exacerbated by back belt use" (LaBar, 1996, p. 34). "The International Association of Fire Fighters has published an excellent guidance summary regarding back belts and sends out a collection of articles supporting their recommendations against the use of back belts, in general, and prescription of exercise as a prevention strategy" (United States Fire Administration, 1996, p. 5-11).

The findings and observations of those in the literature review convinced this researcher that back pain is not a symptom of a disease and that many back injuries are preventable. After reviewing numerous articles concerning back injuries and prevention, it is clear that those who write articles in fire service and other periodicals agree that prevention of back injuries is possible. By following specific guidelines for lifting and carrying, by participating in a physical fitness program to maintain adequate strength, muscular endurance and flexibility, and by implementing an ergonomics program for the fire service the department will have healthier, stronger backs in the future.

PROCEDURES

Definitions of Terms

Degenerated Disc	Results when wear and tear on a disc slowly destroys its structure.
Ergonomics	A type of engineering that aims to design appliances, technical systems and tasks in such a way as to improve human safety, health, comfort and

performance.

Flexibility The ability to move the joints of the body through their normal range of motion and, at times, to be able to move to the very end of range without harm.

Muscular Endurance Refers to the ability of a particular muscle group to produce, or withstand, a moderate force over a longer period of time.

Muscular Strength Refers to the greatest amount of force a muscle group - can produce, or withstand, for a very short period of time.

Sprain The result of overexertion or excess force applied to ligaments or tendons.

Strain The result of overexertion or excess force applied to a muscle.

Research Methodology

Action methodology was used to research the problem. The goals of the action research were to implement a back injury reduction program for East Lake Fire and Rescue, and assist other departments that need help in developing and implementing a back injury reduction program.

Resources available at the National Emergency Training Center's Learning Resource Center (LRC) at the National Fire Academy, including periodicals and past Applied Research Projects relating to back injuries and ergonomics programs were used in this research. Additional information was obtained from the Clearwater Public Library in Clearwater, Florida.

The International Association of Firefighters (IAFF), through Local 1158, East Lake Firefighter Association, provided an information package on back injury statistics. The National Fire Protection

Association provided information, Patterns of Firefighter Injuries. In on-line research, information was obtained from the National Institute of Occupational Safety and Health (NIOSH), and The Occupational Health and Safety Administration (OSHA), and other related sources.

A five question survey (See APPENDIX C) was developed and distributed to the members of East Lake Fire & Rescue, the purpose of which was to determine the opinions of the members of the department concerning: the present use of back belts as part of the department's safety equipment.

The following questions were answered according to this research:

1. Why is the back so prone to injury?
2. What are the components of a back injury reduction program for firefighters?
3. Should the use of back belts be a component of a back injury reduction program?

Limitations

National Institute of Occupational Safety and Health has concluded that, "because of limitations of the studies that have analyzed workplace use of back belts, the results can not be used to either support or refute the effectiveness of back belts in injury reduction" (National Institute of Occupational Safety and Health, 1994, p. 2).

The survey was limited to the members of East Lake Fire & Rescue, and therefore was not a random survey. It was assumed that all members responding to the survey answered truthfully. Further, it was assumed that the members understood the questions in the survey. However, neither of these assumptions can be proven.

The information from the Log and Summary of Occupational Injuries, Diseases and Illnesses was limited due to confidentiality. It was a summary of many injury reports, and was not based on

individual data.

RESULTS

Answers to Research Questions

Research Question 1: Why is the back so prone to injury?

The back is one of the most complex structures in the body consisting of 24 vertebrae stacked in a column surrounded by the paraspinal musculature. It is required to continually support the body at all times: at rest, play and work. It's one of the most neglected parts of the body in activities of daily life. "Over 90 % of all back injuries are not due to a sudden trauma. They are instead the last straw of many years of a micro damage that accumulates, caused by poor posture, improper body mechanics, and poor lifting techniques" (Pearson, 1995, p. 164).

Muscle weakness is a significant problem for the low back, and a frequent cause of injury. Low levels of muscular strength most likely contribute to the high incidence of strains, sprains and back injuries among fire fighters. Weak abdominal muscles also contribute to low back pain and low back injury

. Research Question 2: What are the components of a back injury reduction program for firefighters?

The components of a back injury reduction program are: strength, muscular endurance, flexibility, and ergonomics.

The members of East Lake Fire & Rescue are already under contractual agreement with the YMCA within its jurisdiction to participate in a fitness program which is one component of the established wellness program for the department. It has been decided based on this research

to expand the fitness component to include the YMCA's *Healthy Back Program*. The YMCA has offered back exercise as a component of a health and fitness programs since 1974. The *Healthy Back Program* is designed as a preventive course, and includes a total of 20 exercises, presented in three levels of progression, from easy to challenging. (See Appendix A) The course has been arranged to meet 1 - 2 times per week for 6 - 8 weeks. Class time ranges from 30 - 45 minutes. The course objectives are: to increase muscular strength, endurance, and flexibility; and to educate in proper lifting techniques and body mechanics.

The National Institute for Occupational Safety and Health (NIOSH) believes that the most effective way to prevent back injury is to implement an ergonomics program that focuses on redesigning the work environment and work tasks to reduce the hazards of lifting. After careful review, it was decided to implement, *Fire and Emergency Medical Services Ergonomics: A Guide for Understanding and Implementing an Ergonomics Program in Your Department*, published by The United States Fire Administration.

Research Question 3: Should the use of back belts be a component of a back injury reduction program?

Companies should not rely on back belts as a "cure all" for back injury, but should begin to undertake prevention measures which reduce the risks of lifting tasks. Although back belts are being bought and sold under the premise that they reduce the risk of back injury, there is insufficient scientific evidence that they actually deliver what is promised. In May 1994, NIOSH working group said "it was [unproven] that back belts lessen the risk of back injuries among healthy workers. It said it could not recommend their use and did not consider them personal protective equipment" (LaBar,1996,p.33). In

May 1995, the state OSHA program in Minnesota issued a page statement: "It warned that more than a dozen medical conditions, ranging from hypertension to breathing problems, could be exacerbated by back belt use " (LaBar, 1996, p.34).

The results of the survey given to the members of ELF&R indicated that 85% do not believe that the back belt is a valuable part of their safety equipment, and do not use it on a regular basis. Most would like to see it discontinued. (See Appendix C)

DISCUSSION

The good news is that firefighter deaths are on a decline; the bad news is that injuries are on an incline. Sprains and strains, along with back injuries are at the top of the list according to the 1997 International Association of Fire Fighters (IAFF) Annual Death and Injury Survey report. This may be the result of improvements in injury reporting with the updated computer system from the National Fire Incident Reporting System (NFIRS). After a review of numerous references at the LRC at the National Fire Academy, it was found that the subject of back injury is not getting its fair share of attention. The most recent Applied Research Project on back injuries was written in 1995. Only one Applied Research Project was found written about ergonomics programs to reduce injuries.

Modern society as a whole is becoming less active with the increasing convenience of every day life. This trend in life styles toward inactivity creates the potential of developing weaker muscles, especially in the back, which leads to back pain. "You can get caught in the cycle of chronic disuse atrophy, in which you rest because your back hurts, your back muscles become even weaker from inactivity, and your back hurts even more" (Kandel & Sudderth, 1996, p.108). Participation in a physical fitness program with back exercises as a component is a way out of the cycle.

In a study of strength and fitness and subsequent back injuries in firefighters, Cady et al.

(1979) investigated whether high levels of physical fitness had a protective effect against injuries.

The results of their investigation demonstrated “that the most fit individuals (contrasted with the least fit individuals) had fewer subsequent back injuries” (p.271).

In his book, *Backs in Motion*, Maharam discussed the benefits of a strong back in the prevention of back injuries. He used the analogy of a straw in a cup. The straw represents the spinal column-its vertebrae, disks, and nerves. The cup is the trunk surrounded by the paraspinal musculature, tendons and ligaments. The stronger the cup, the better protected the straw. The stronger the trunk, the safer the spine (Maharan, 1996, p. 18). This analogy agrees with the findings in Cady’s study.

Maharan used another analogy in his discussion on the benefits of flexibility. He compared muscles to a piece of meat. Meat that is frozen is brittle and easily torn. Compare this to a piece of meat that is warm. It is elastic, flexible and less likely to tear. Muscles are similar. A muscle that is warmed up and used to being stretched has a better range of motion. Muscles that are inactive and inflexible are more like the frozen meat, and more likely to tear, causing pain and injury (Maharan, 1996, p.57).

Flexibility is an important component of the *Healthy Back Program* at the YMCA. The YMCA has offered this program to millions of people across the USA since 1974. It is a proven preventive back intervention. In 1994, the *Healthy Back Program* was updated to include current developments in exercise technology for better strength, endurance and flexibility of the back musculature. Expanding the fitness component of the Wellness Program at East Lake Fire & Rescue to include the *Healthy Back Program* will lead to increased fitness for the members of the department and decreased incidence of back injuries.

Ergonomics is another example of advanced technologies being used to improve health and safety of individuals in the workplace. It is a new field of study, as evidenced by the fact that there has been only one Applied Research Project written about ergonomics at the LRC of the National Fire Academy. In Mallory's research, he found that approximately 89 % of all reported firefighter injuries are related to ergonomics (p. 5). Administrative and engineering controls in ergonomics dealing with the firefighter's workplace environment can significantly reduce exposure to injuries.

Obviously, the firefighters most dangerous workplace, the emergency scene, can not be controlled completely, but the inherent hazards can be minimized. The work method (administrative controls) and equipment used at the scene (engineering controls) can be modified to reduce the dangers present at emergency incidents. The same approaches can also make firefighters safer in other work-places (LeCuyer, 1994, p. 34).

East Lake Fire & Rescue currently uses back belts as part of their protective equipment. The survey distributed to the members of the department tried to determine the opinions of the firefighter on the value and actual use of the back belts in their employment at ELF&R. The opinions of the members, as well as the recommendations of the National Institute of Occupational Safety and Health (NIOSH), Occupational Safety and Health Administration (OSHA) and the International Association of Firefighters (IAFF) were considered for the final recommendation of this Applied Research Project.

RECOMMENDATIONS

As a result of the research for this applied Research Project the recommendations for implementation at East Lake Fire and Rescue are:

Recommendation 1: Implement the component of the *Healthy Back Program* for the

education and instruction of the members of East Lake Fire & Rescue about the causes of back pain, proper posture, and correct body mechanics and lifting techniques.

Recommendation 2: To expand the service that the YMCA offers to ELF&R to include the *Healthy Back Program*. In addition, to set up a sub-committee from the members of the department to implement the *Fire and Emergency Medical Services Ergonomics: A Guide for Understanding and Implementing an Ergonomics Program in Your Department*.

Recommendation 3: Back belts will not be used in the future at ELF&R. The back belts that are part of the protective equipment of the department will be removed from the safety equipment inventory.

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YMCA Healthy Back Program



YMCA of the USA

The Healthy Back Exercises

The new participant book published in 1994, *The YMCA Healthy Back Book*, introduces a completely redesigned exercise format for the YMCA Healthy Back Program. A total of 20 exercises are included, presented in three levels of progression from easy to more challenging. This provides many options for designing programs using different combinations and repetitions of the exercises. These exercises are appropriate for the majority of participants and should be the foundation of any YMCA Healthy Back Program.

This class can be offered in a number of different formats:

- **Seminar.** In this format participants meet once for 1 1/2 to 2 hours to review the exercises and basic principles. The seminar includes the participant book and/or video for home exercise.
- **Short-term class.** A short-term course can meet for 30 to 45 minutes 2 or 3 times a week for 2 to 4 weeks. Home exercise on all non-class days is essential.
- **Long-term class.** A long-term course can meet for 30 to 45 minutes 1 or 2 times a week for 6 to 8 weeks. Home exercise on all non-class days is essential.

In all of these options, encourage participants to exercise at their own pace and level, progressing as their performance and comfort improves.

Healthy Back Program Class Format

Here is a suggested format for the four components of a 30-minute Healthy Back exercise class: warm-up, stretching, the Healthy Back Exercises, and cool-down and relaxation.

Warm-Up (5 min)

Warm-up prepares the body for exercise by increasing blood flow to the muscles. The warm-up should consist of a rhythmic, full-range-of-motion activity such as slow walking. This will warm the muscles slightly, making the stretching and strengthening exercises to follow easier and more effective.

Ask participants to keep a weekly exercise log so you can monitor their progress. A sample log appears at the end of this chapter.

The following are the muscle groups and their corresponding exercises at each level. Page numbers indicate where directions for the exercises appear in the *YMCA Healthy Back Book*. The recommended number of repetitions is listed for each exercise.

Postural Muscle Strengthening

Level 1: Pelvic tilt (standing) and pelvic tilt (on your back) (pp. 38, 39), 15-20 reps each

Level 2: Wall slide (p. 44), 5-10 reps of 10-20 sec each

Level 3: Supine bracing (p. 56), 10-20 reps per leg

Back Stretch

Level 1: Back arch (p. 40), 5-10 reps

Levels 2 and 3: None

Hip Flexor/Extensor Stretch

Level 1: Knees to chest (p. 41), 5-10 reps per leg

Level 2: Hip flexor stretch (p. 47), 5-10 reps per leg

Level 3: Hip flexor stretch (advanced) (p. 52), 3-5 reps per leg

Hamstring Stretch

Level 1: Leg raise (p. 42), 5-10 reps per leg

Level 2: Single leg raise (p. 46), 5-10 reps per leg

Level 3: Single leg raise (advanced) (p. 54), 5-10 reps per leg

Chest/Abdominal Stretch

Level 1: Prone on elbows (p. 43), 1 rep for 15-30 sec

Level 2: Press up (p. 49), 5-10 reps

Level 3: None

Abdominal Strengthening

Level 1: None

Level 2: Trunk curl (p. 48), 15-30 reps

Level 3: Diagonal curl (p. 55), 10-15 reps per side

Lower trunk rotation (p. 53), 5-10 reps

Hip Extensor Strengthening

Level 1: None

Level 2: Quadruped (p. 45), 5-10 reps per limb

Level 3: Quadruped (advanced) (p. 51), 5-10 reps per pair

Back Extensor strengthening

Level 1: None

Level 2: Prone extension (p. 50), 10-15 reps per pair

Level 3: Upper trunk raise (p. 57), 5-10 reps

The sequence for the exercises, which is the same sequence as in the *YMCA Healthy Back Book*, is as follows:

Level 1

Pelvic tilt (standing)

Pelvic tilt (on your back)

Back arch

Stretching (5 min)

This part of the class is for mild, preliminary stretching after the body is warmed up and before beginning more vigorous exercise. The stretches are performed slowly and gently while standing or sitting in a chair. Here are some stretches to try:

Neck Muscles

- *Head circles:* Slowly circle the head forward from the right shoulder to the left shoulder. Reverse. Repeat a few times. Do not circle the head to the back, as this can place undue stress on the cervical spine.
- *Head tilts:* Slowly tilt the head so that the right ear moves down toward the right shoulder. Hold, then repeat on the left side.
- *Head rotations:* Slowly rotate the head by looking over the right shoulder. Hold, then repeat to the left.

Shoulder Muscles

- *Shoulder shrugs:* Raise both shoulders up toward the ears, hold, then lower down. Repeat.
- *Shoulder circles:* Circle both shoulders backward 8 to 10 times.
- *Arm raises:* Holding both hands at shoulder level, slowly reach up with one hand, straightening the arm. Lower, then repeat with the other arm.

Trunk Muscles

- *Forward bend:* With arms in front and knees bent, bend forward at the waist, slowly and without straining. Head should go no lower than the waist. Slowly raise back up. Repeat two more times.
- *Side bend:* With arms at sides, slowly bend the trunk to the right side, hold, and raise back. Repeat to left side. Continue alternating sides for 5 repetitions.
- *Backward bend (perform standing only):* Place palms of hands on lower back and slowly bend backward at the waist, supporting the back with the hands. Do not extend the back more than a few degrees past the upright position or past the point of comfort. Repeat 2 more times.

The Healthy Back Exercises (15 min)

This part of the class is designed to improve the strength and flexibility of specific muscle groups related to the back. These exercises are described in the next section and appear in the *YMCA Healthy Back Book*. There are three levels of exercises, from easy to more challenging. Instruct class participants to perform each exercise at their appropriate level within the group class.

When a program begins, teach the Level 1 exercises to all participants. They should do these six exercises in class and every non-class day at home. After the first week, begin to introduce the Level 2 exercises. Participants should progress to that level at their own pace and only after they are able to perform the recommended number of repetitions of the Level 1 exercises. When they can complete the recommended number of repetitions of the Level 2 exercises, introduce the Level 3 exercises.

Some individuals may exercise only at Level 1 throughout the course; this is fine. For those ready to progress, encourage them to add higher levels of exercise gradually, emphasizing good posture and technique.

Each exercise should be performed slowly and with control. Tell participants to concentrate on the contracting muscles. Instruct them to exhale when the muscle is shortening and inhale when the muscle is lengthening. They should never hold their breath.

Knees to chest
Leg raise
Prone on elbows

Level 2

Wall slide
Quadruped
Single leg raise
Hip flexor stretch
Trunk curl
Press up
Prone extension

Level 3

Quadruped (advanced)
Hip flexor stretch (advanced)
Lower trunk rotation
Single leg raise (advanced)
Diagonal curl
Supine bracing
Upper trunk raise

Cool-Down and Relaxation (5 min)

Use various relaxation techniques for a cool-down phase of the class. Have participants lie on their backs on a mat or other comfortable surface with knees bent and feet flat on the floor. Refer to the *YMCA Healthy Back Book* (pp. 96-101) for suggestions.

Exercise Descriptions

This section provides illustrations and instructions for each exercise at all three levels.

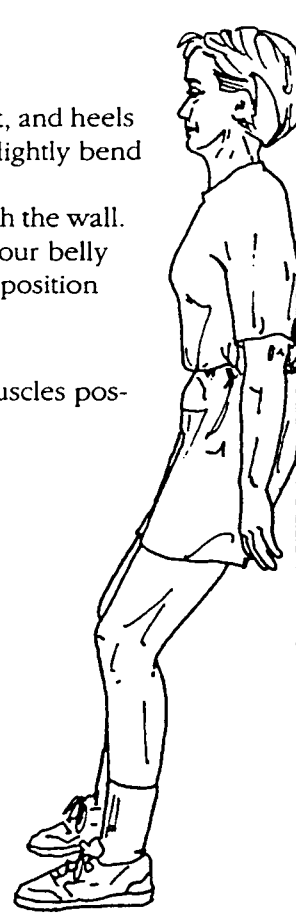
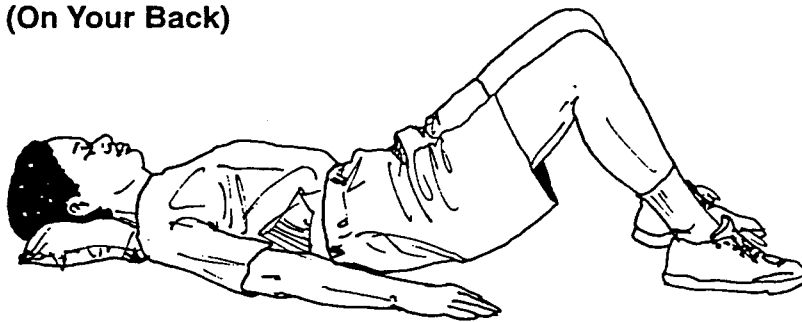
Level 1**Pelvic Tilt (Standing)**

Stand with your back against a wall, feet shoulder-width apart, and heels 12 to 18 inches (about 30 to 46 centimeters) from the wall. Slightly bend your knees.

Rotate your pelvis so your lower back comes in contact with the wall. Tighten your lower abdominal muscles (the muscles from your belly button to the tops of your legs) and hold this "pelvic brace" position for 2 to 5 seconds.

Repeat 15 to 20 times.

Purpose: Strengthen abdominal and stretch lower back muscles postural muscles

**Pelvic Tilt (On Your Back)**

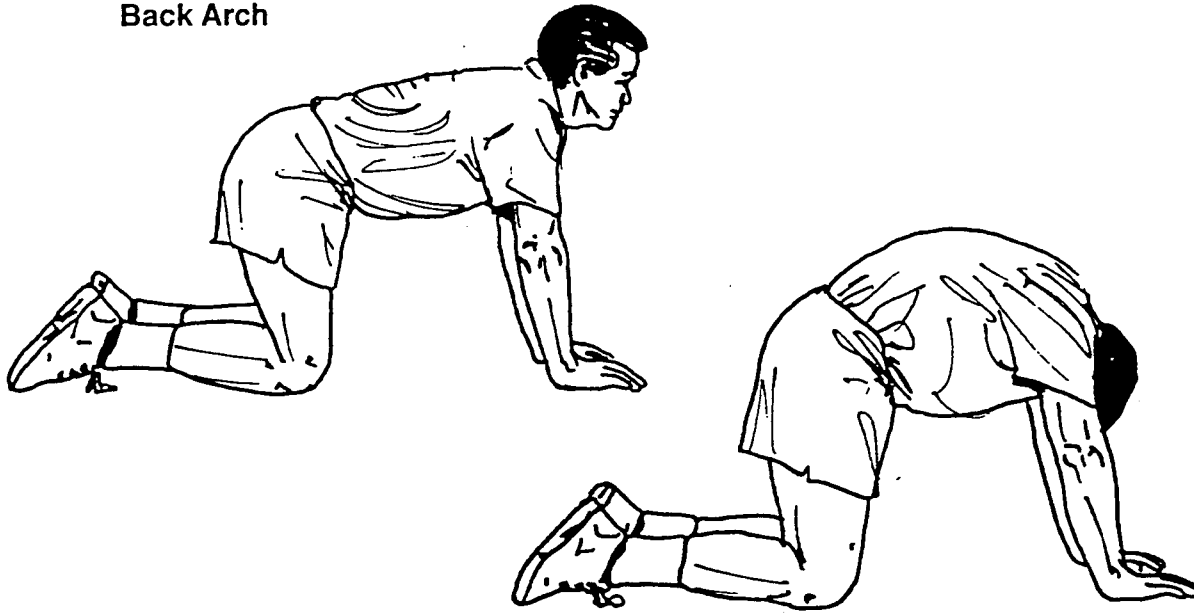
Lie on your back with both knees bent, feet flat on the floor, and arms at your sides. (You may wish to place a small pillow under your head or neck.)

Exhale and rotate your pelvis so your lower back comes in contact with the floor. Tighten your lower abdominal muscles and hold this "pelvic brace" position for 2 to 5 seconds.

Repeat 15 to 20 times.

Purpose: Strengthen postural muscles

Back Arch



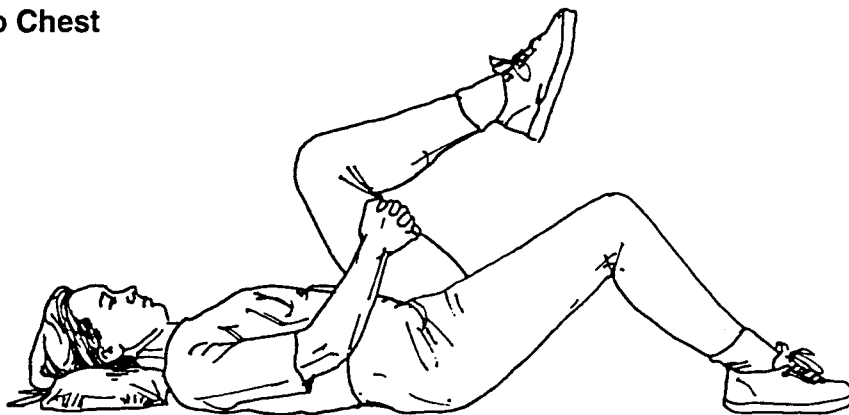
Get on all fours on the floor and pull in your abdominal muscles.

Drop your head forward and round your back as you tilt your pelvis. Hold for 5 seconds. (See the pelvic tilt exercises if you have trouble understanding how to tilt your pelvis.)

Repeat 5 to 10 times.

Purpose: Stretch back muscles

Knees to Chest



Lie on your back with both knees bent, feet flat on the floor, and arms at your sides. (You may wish to place a small pillow under your head or neck.) Do a pelvic tilt and hold. (Your abdominal muscles should be tight.)

Exhale, and pull one knee toward your chest and hold for 5 seconds.

Alternating sides, repeat 5 to 10 times per leg. When it feels comfortable, try pulling first one, then both knees toward your chest at the same time. Hold your pelvic tilt and don't rock.

Purpose: Stretch hamstring and hip extensors

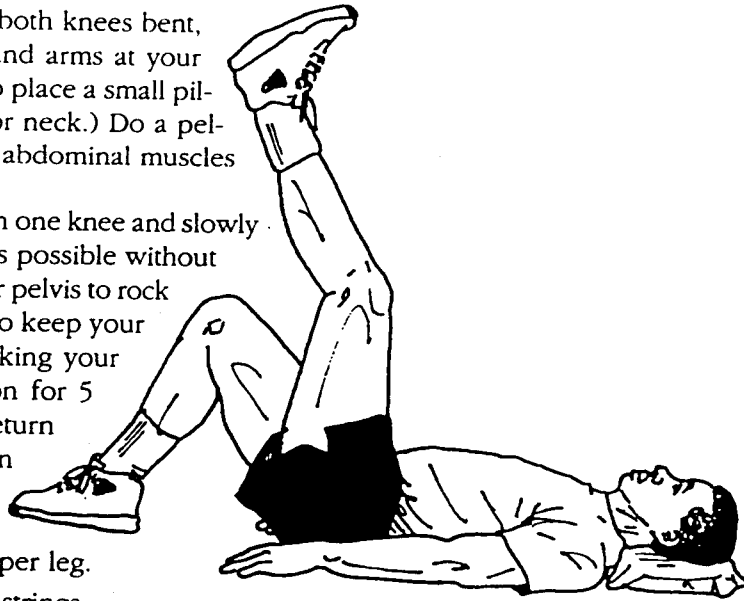
Leg Raise

Lie on your back with both knees bent, feet flat on the floor, and arms at your sides. (You may wish to place a small pillow under your head or neck.) Do a pelvic tilt and hold. (Your abdominal muscles should be tight.)

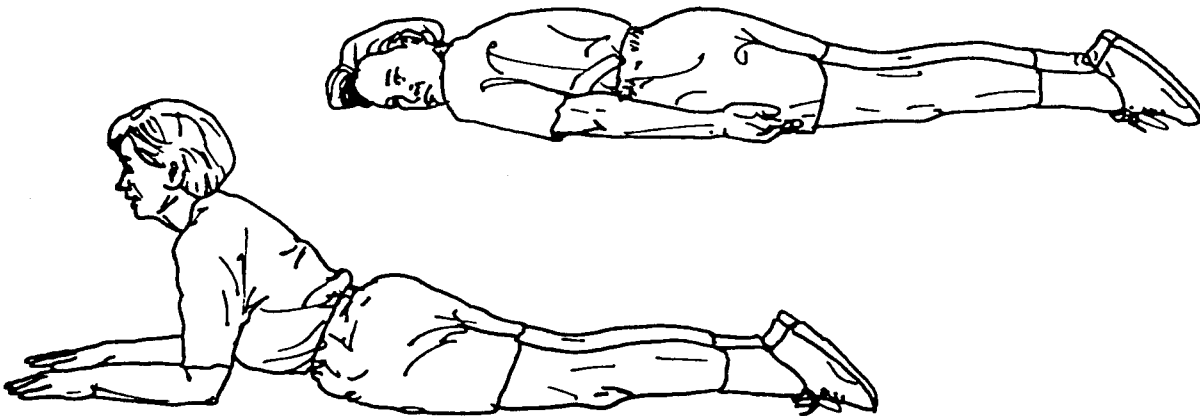
Exhale, and straighten one knee and slowly raise your leg as high as possible without pain. (Do not allow your pelvis to rock or to roll upward.) Try to keep your leg straight without locking your knee. Hold this position for 5 seconds, then slowly return it to the original position with knee bent and foot on the floor.

Repeat 5 to 10 times per leg.

Purpose: Stretch hamstrings



Prone on Elbows



Lie facedown on the floor with your arms at your sides and your head turned to one side. Take deep breaths and try to relax for 3 to 5 minutes.

Place your elbows under your shoulders as you ease your trunk up, then rest your weight on your forearms. (Use your shoulders and arms to push your head and upper trunk up; do *not* use your back muscles to lift.) Look straight ahead. Hold this position for 15 to 30 seconds.

Do once per exercise session.

Purpose: Stretch chest and abdominal muscles

Level 2

Wall Slide

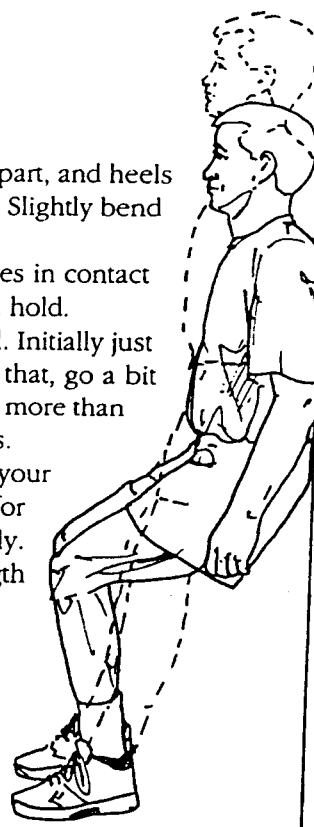
Stand with your back against a wall, feet shoulder-width apart, and heels 12 to 18 inches (about 30 to 46 centimeters) from the wall. Slightly bend your knees.

Exhale, and rotate your pelvis so your lower back comes in contact with the wall. Tighten your lower abdominal muscles and hold.

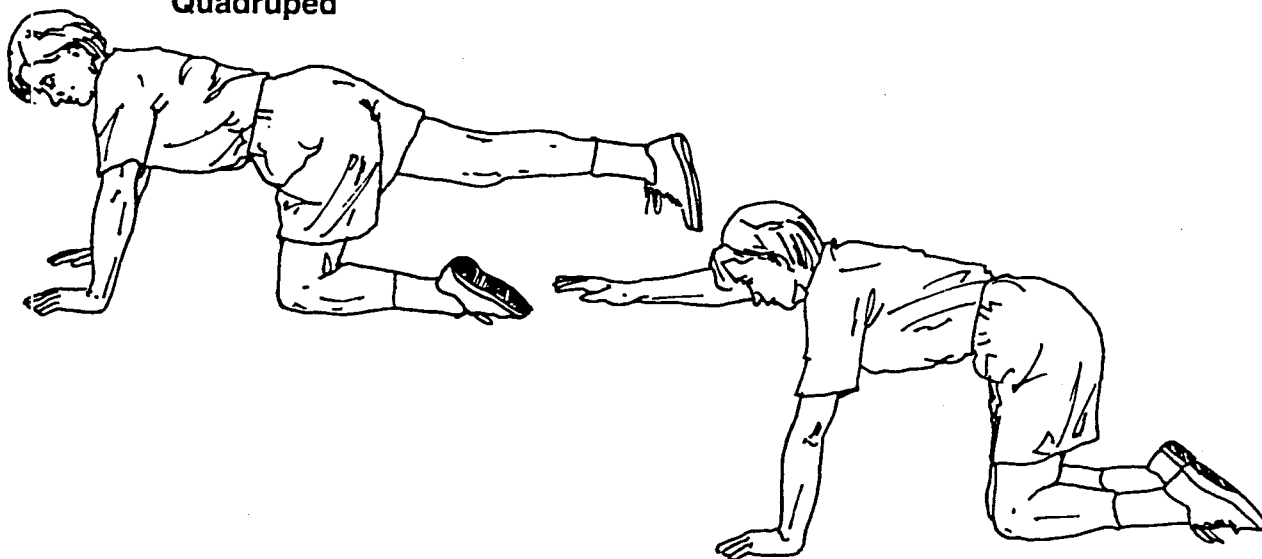
Bend your knees while sliding your back down the wall. Initially just bend your knees slightly; when you are comfortable with that, go a bit farther and then a bit farther. Do not ever bend your knees more than 90 degrees. Hold the bottom position for 10 to 20 seconds.

Repeat 5 to 10 times. This exercise also strengthens your abdominal and thigh muscles. Try to build up to holding for 2 minutes. If your knees hurt, try bending them only slightly. Reduce the number of repetitions as you increase the length for which you hold each repetition.

Purpose: Strengthen postural and thigh muscles



Quadruped



Get on all fours on the floor. Brace your pelvis by pulling in your abdominals and holding your back in a pain-free position.

Slowly raise each arm and each leg, one at a time, to a horizontal position. Hold each up for 5 seconds, then lower it. Do not allow your trunk to sag by maintaining your pelvic brace, and keep your eyes on the floor.

Repeat 5 to 10 times per limb. It is very important that your trunk not sag or tilt during this exercise, so the first few times you try it either watch yourself in a mirror or have a friend watch you.

Purpose: Strengthen back hip extensors

Single Leg Raise

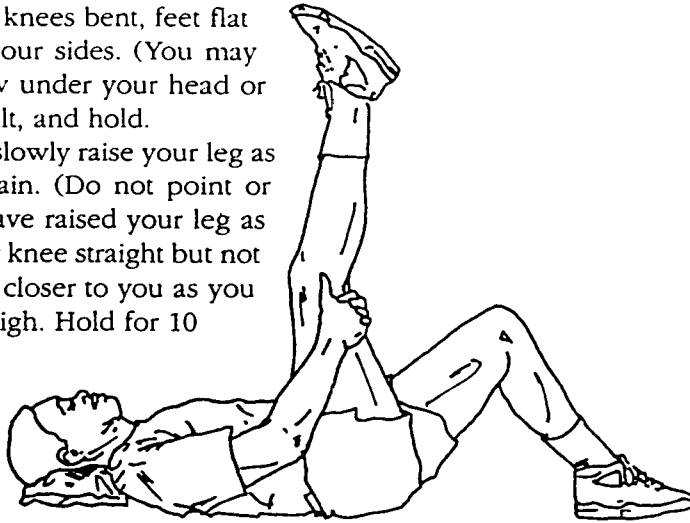
Lie on your back with both knees bent, feet flat on the floor, and arms at your sides. (You may wish to place a small pillow under your head or neck.) Exhale, do a pelvic tilt, and hold.

Straighten one knee and slowly raise your leg as high as possible without pain. (Do not point or flex your foot.) After you have raised your leg as far as you can, keeping your knee straight but not locked, gently pull your leg closer to you as you contract the front of your thigh. Hold for 10 seconds.

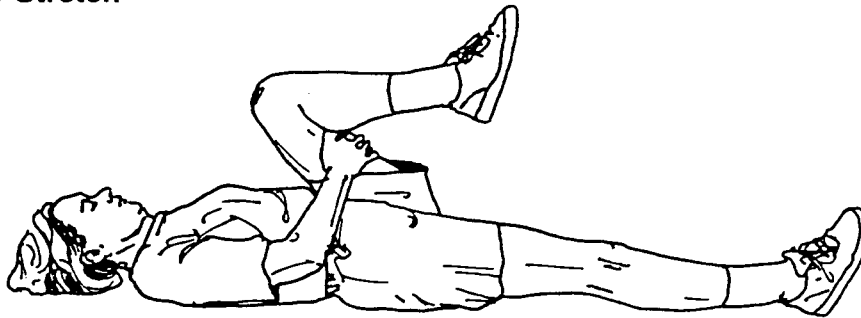
Repeat 5 to 10 times per leg. Your goal should be to raise each leg a minimum of 80 degrees off the floor.

Purpose: Stretch hamstrings

Caution: If you have sciatica, consult with your physician before attempting the Single Leg Raise. Don't do it when your sciatica is painful.



Hip Flexor Stretch



Lie on your back with legs straight and arms at your sides.

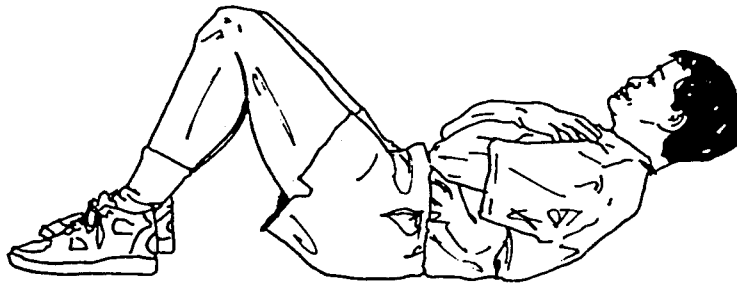
Grasp one thigh behind your knee and pull it toward your chest until your lower back is in contact with the floor. Keep the opposite leg straight at the same time.

If your extended leg does not stay on the floor, hold this position 5 to 10 seconds. If you are doing this exercise correctly and your extended leg *is* in contact with the floor, you don't need to perform this exercise.

Repeat 5 to 10 times per leg if your extended leg does not stay on the floor. If it does, eliminate this exercise from your routine; however, you may want to try this exercise periodically to make sure your hip flexors are still flexible.

Purpose: Stretch hip flexors

Trunk Curl



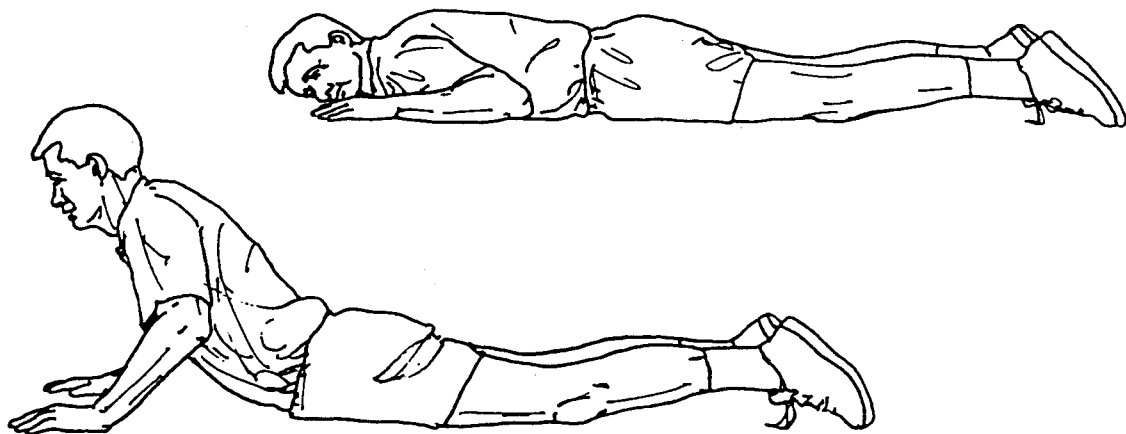
Lie on your back with both knees bent and feet flat on the floor. Cross your arms across your chest, do a pelvic tilt, and hold.

Keeping your lower back in contact with the floor, exhale and slowly raise your shoulder blades off the floor, then lower them, inhaling as you return to the starting position. Keep your eyes on the ceiling; try not to bend your neck forward.

Repeat 15 to 30 times.

Purpose: Strengthen abdominals

Press Up



Lie facedown on the floor with your hands by your shoulders.

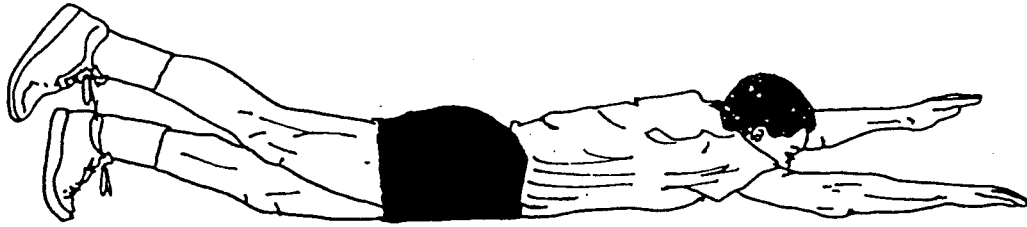
Keeping your weight on your hands, use your shoulders and arms to push your head and upper trunk up; try to keep the other parts of your body relaxed. Do not use your back muscles to lift. Keep your pelvis on the floor. Hold the upper position for 2 seconds, keeping your eyes straight ahead, and then lower yourself.

Repeat 5 to 10 times. Each time you repeat, extend your arms a bit farther.

Purpose: Stretch chest and abdominal muscles

Caution: If you are an older adult, consult with your physician before attempting the Press Up.

Prone Extension



Lie facedown with your arms extended over your head on the floor.

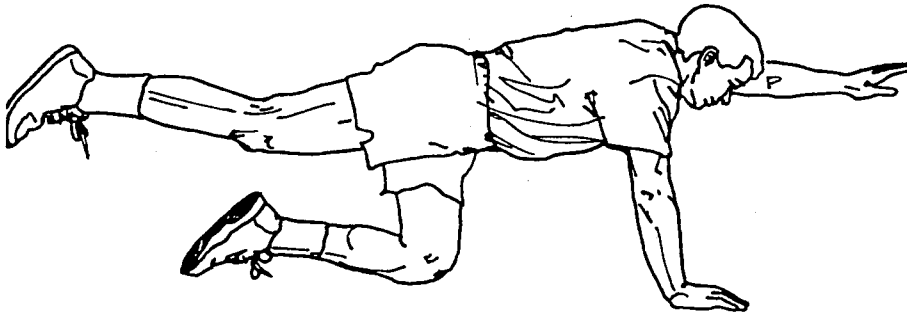
Exhale, slowly lift your left arm and right leg 6 to 12 inches (about 15 to 30 centimeters) off the floor, and hold for 3 to 5 seconds. Keep your eyes on the floor. Do not hold your breath. Lower your arm and leg, then do the same exercise using your right arm and left leg.

Repeat 10 to 15 times per pair.

Purpose: Strengthen back extensors

Level 3

Quadruped (Advanced)



Get on all fours on the floor. Brace your pelvis by pulling in your abdominals and holding your back in a pain-free position.

Slowly raise your left arm and right leg. Hold for 5 seconds. Do not allow your trunk to sag, and keep your eyes on the floor. Repeat the exercise using your right arm and left leg.

Repeat 5 to 10 times per pair.

Purpose: Strengthen hip extensors

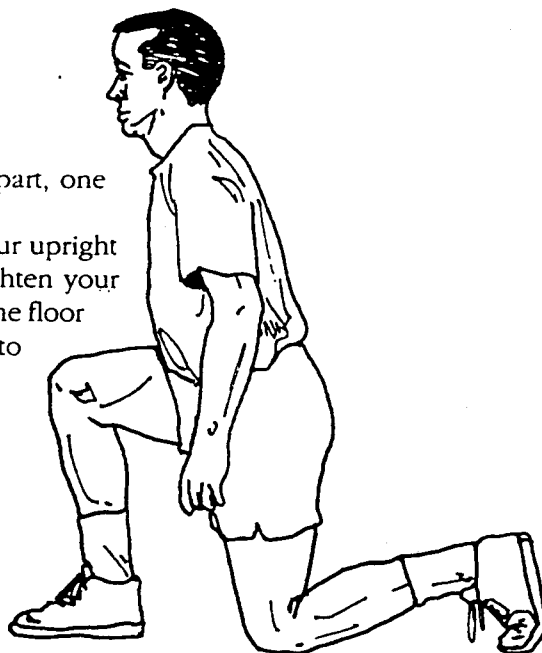
Hip Flexor Stretch (Advanced)

Stand with your feet shoulder-width apart, one foot forward and one foot behind you.

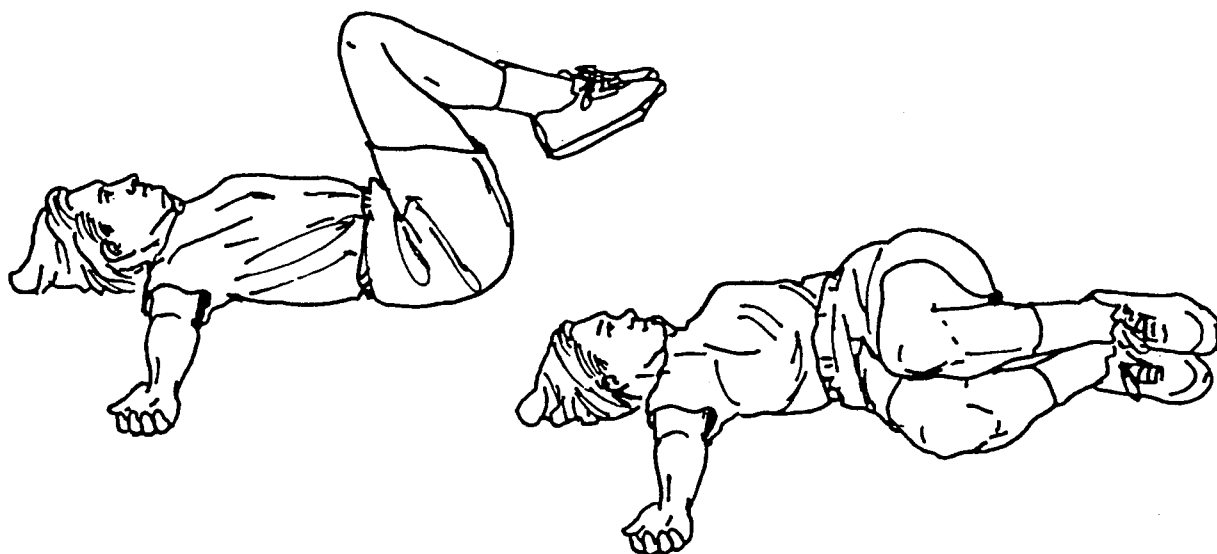
Bend your forward leg, lowering your upright trunk (keep your back straight and tighten your abdominals). Place your back knee on the floor and lean forward slightly. Hold for 5 to 10 seconds, looking straight ahead.

Repeat 3 to 5 times per leg.

Purpose: Stretch hip flexors



Lower Trunk Rotation



Lie on your back with both knees bent and feet flat on the floor. Extend your arms out to your sides.

Slowly bring both knees toward your chest. Then rotate your knees to one side as far as is comfortable. Hold for 5 seconds.

Slowly bring both knees up and over to the other side as far as is comfortable. Hold for 5 seconds.

Repeat 5 to 10 times.

Purpose: Strengthen abdominal and stretch oblique muscles

Single Leg Raise (Advanced)

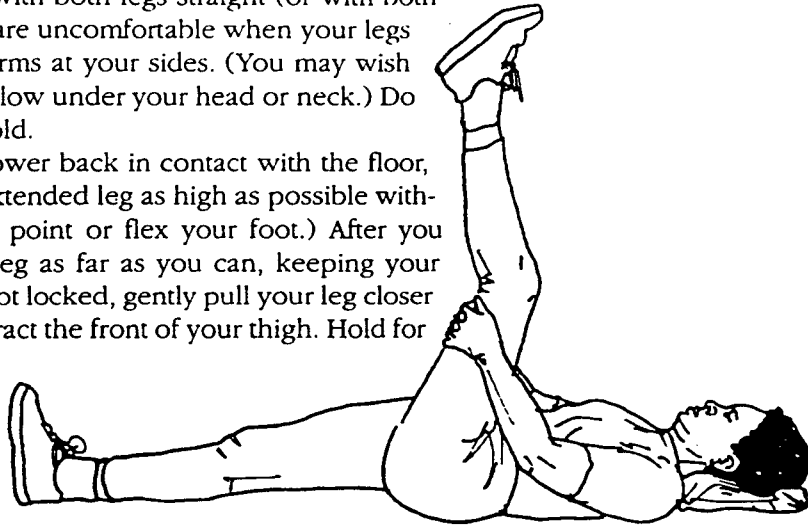
Lie on your back with both legs straight (or with both knees bent if you are uncomfortable when your legs are straight) and arms at your sides. (You may wish to place a small pillow under your head or neck.) Do a pelvic tilt and hold.

Keeping your lower back in contact with the floor, slowly raise one extended leg as high as possible without pain. (Do not point or flex your foot.) After you have raised your leg as far as you can, keeping your knee straight but not locked, gently pull your leg closer to you as you contract the front of your thigh. Hold for 10 seconds.

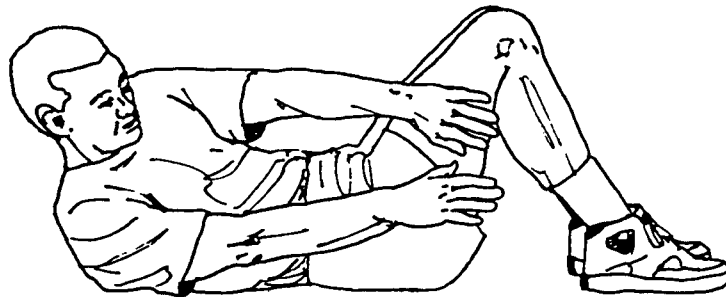
Repeat 5 to 10 times per leg. Your goal should be to raise each leg a minimum of

80 degrees off the floor; the position of your pelvis makes this more difficult than the earlier exercise if both legs are straight when you start raising one leg.

Purpose: Stretch hamstrings



Diagonal Curl



Lie on your back with both knees bent, feet flat on the floor, and arms at your sides.

Exhale, and lift your trunk slightly. While lifting, rotate your trunk slightly by reaching both arms toward the right side of your right knee, lifting your left shoulder off the floor (your right shoulder may still be in contact with the floor). Look at your hands.

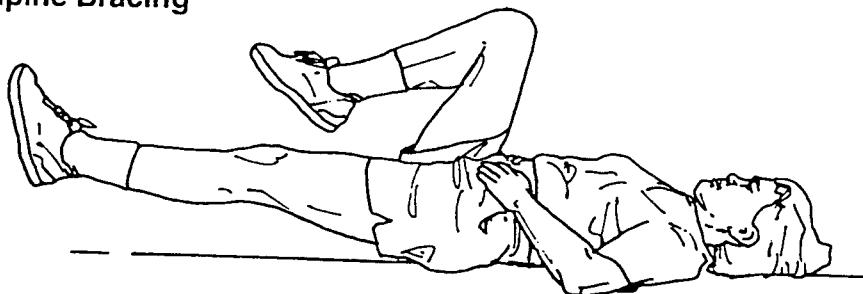
Inhale, and lower your shoulder and head to the floor, then do the same to the left side.

Repeat 10 to 15 times per side. For variation, reduce the number of repetitions but hold your right or left position by contracting your abdominals for 5 to 15 seconds.

Be sure to continue doing trunk curls from Level 2 frequently so you work all of your abdominal muscles.

Purpose: Strengthen abdominal and oblique muscles

Supine Bracing



Lie on your back with your legs straight. Place your hands on your lower abdominals and pull them in, then do a pelvic tilt and hold.

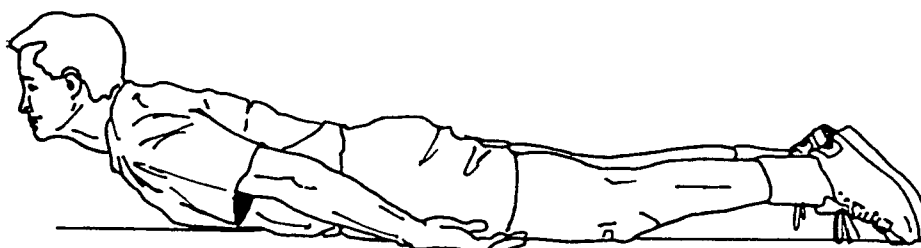
Keeping your lower back in contact with the floor, bring your right leg toward your chest while lifting your left leg off the floor. (Your left leg will be kept straight.) Then do the reverse, bringing your left leg toward your chest while straightening your right. Be sure you keep your abdominals tight and your lower back on the floor.

Repeat 10 to 20 times per leg.

Purpose: Strengthen postural muscles

Caution: If you must restrict your activity due to a cardiac condition, then do not perform Supine Bracing because this exercise requires strong isometric contraction (i.e., contraction against resistance) of your trunk muscles.

Upper Trunk Raise



Lie facedown on the floor, arms at your sides.

Slowly elevate your head and shoulders from the floor. Raise them only to the point where you feel comfortable; don't force it. Keep your head in a neutral position; do not look up. Hold for 5 to 10 seconds.

Repeat 5 to 10 times.

Purpose: Strengthen back extensors

Caution: Don't exceed the normal standing curvature of your lower back.

Exercise Log

Here is a sample weekly exercise log that you can copy to hand out to class participants. Have them fill out this or a similar form so you can keep track of their progress.

YMCA Healthy Back Program Weekly Exercise Log

Name _____ Week of _____

Each week fill in the level of each exercise. Write in the number of repetitions performed daily.

Day	Postural strength	Back stretch	Hip flexor stretch	Hamstring stretch	Abdominal/ Chest stretch	Abdominal strength	Back extensor strength	Hip extensor strength
	Level ____	Level ____	Level ____	Level ____	Level ____	Level ____	Level ____	Level ____
Monday								
Tuesday								
Wednesday								
Thursday								
Friday								
Saturday								
Sunday								

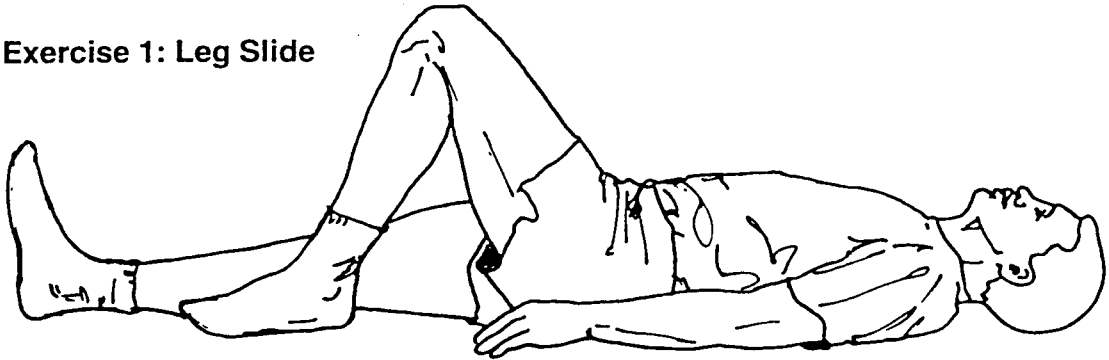
Optional Healthy Back Exercises

The 15 exercises of the original YMCA back program are included as another option, mainly for more deconditioned participants. These exercises are easier to perform than most of those in the new book. The structure of this class is to progressively teach the exercises, starting with the first five and adding one each class and limiting repetitions to three of each exercise. Most YMCAs offer this option as a 6-week course that meets twice a week, using the following format:

Week	Class	Exercise Introduced
1	1	None (Review program theory, principles, and format)
	2	1-5
2	3	6
	4	7
3	5	8
	6	9
4	7	10
	8	11
5	9	12
	10	13
6	11	14
	12	15

Each exercise session always starts with Exercise 1, progresses to the new exercise introduced at that class, then reverses in order back to 1.

Here are the illustrations and instructions for the exercises. They are grouped by the week in which they are introduced (Week 1, Week 2, etc.). Copy these sheets and hand them out to your participants so they can practice at home as well as in class. Please note that exercisers should *not* wear shoes when performing these exercises.

Week 1**Exercise 1: Leg Slide**

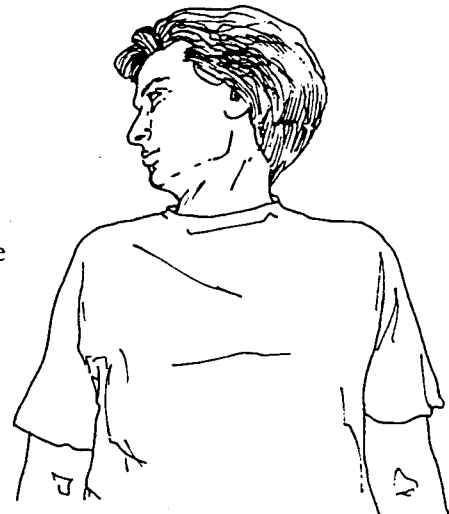
Lie comfortably on your back on a mat on the floor with both knees bent. Close your eyes. Take a deep breath and exhale slowly. Slide one leg out, letting it fall loosely to the floor, and slide it back. Slide the other leg out and slide it back. Repeat twice more.

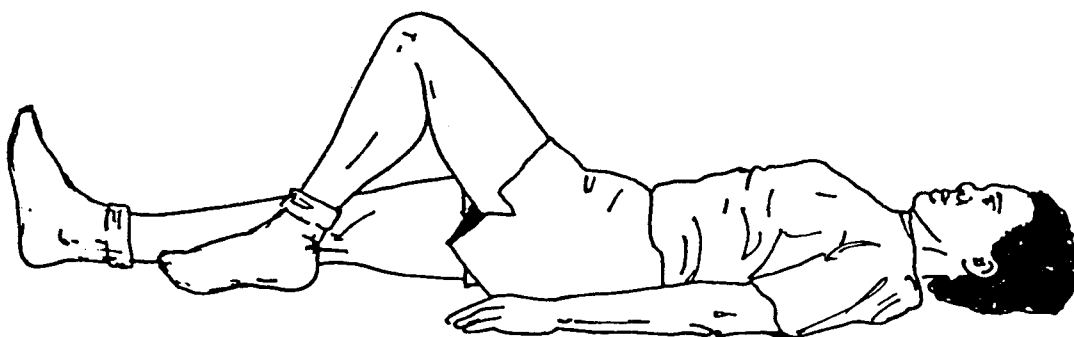
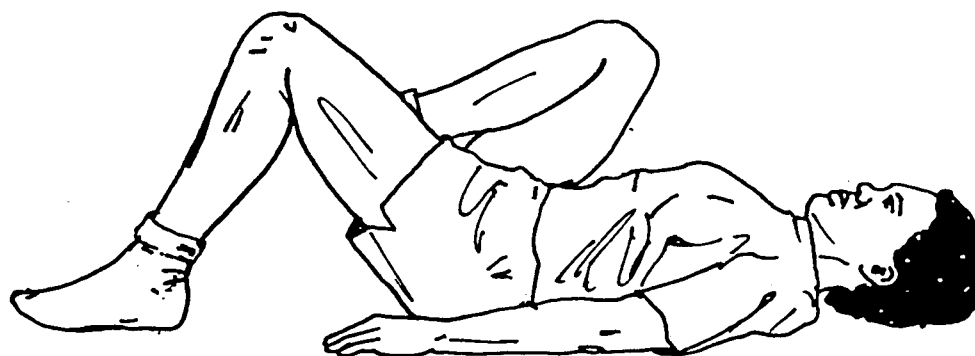
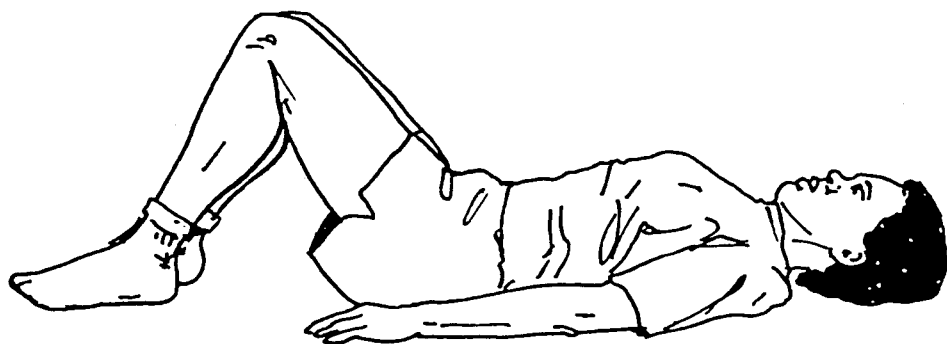
Exercise 2: Shoulder Shrug

Lying on the mat, slowly shrug your shoulders up toward your ears, sliding them along the mat. Release the shrug. Repeat 2 more times.

**Exercise 3: Head Roll**

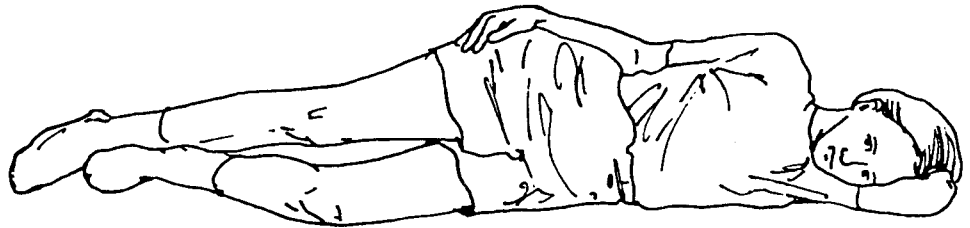
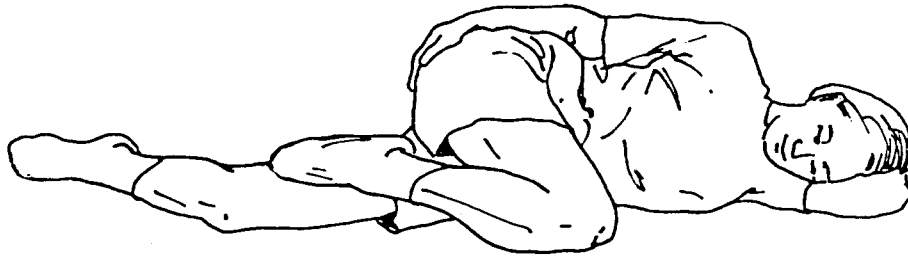
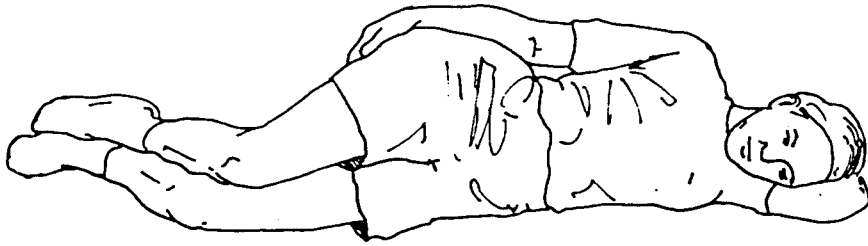
Lying on the mat, turn your head slowly to one side, letting it fall loosely toward the floor. Slowly swing the head to the other side, letting it go loosely as far as it can. Do not force or strain. Turn 3 times to each side.



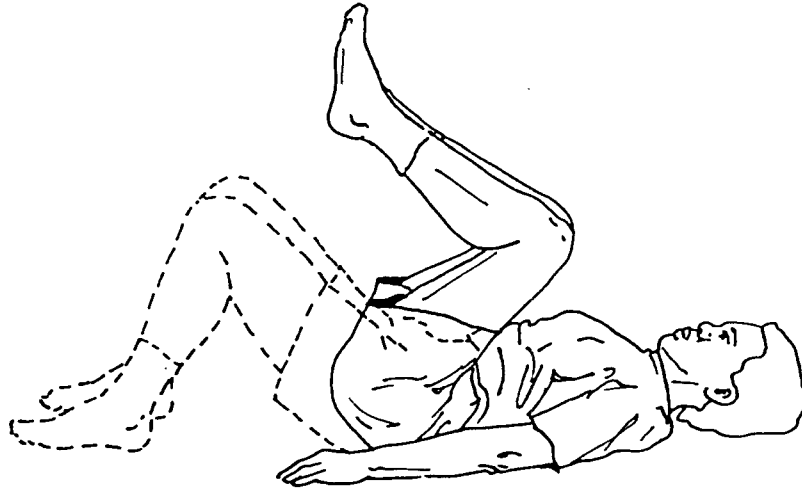
Exercise 4: Knee Lift

Slowly draw one knee up toward your chest, keeping your hips on the floor. Return your foot to the floor, slide your leg out, and then slide it back. Now bring the other leg up, return your foot to the floor, slide your leg out, and slide it back. Perform the exercise 3 times for each leg.

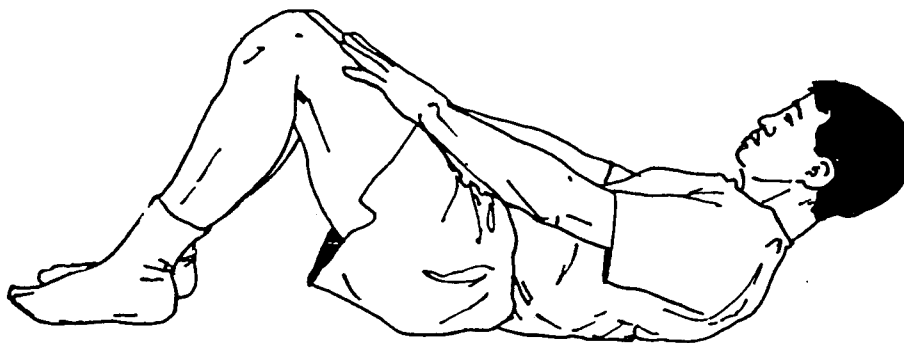
Exercise 5: Side Leg Slide



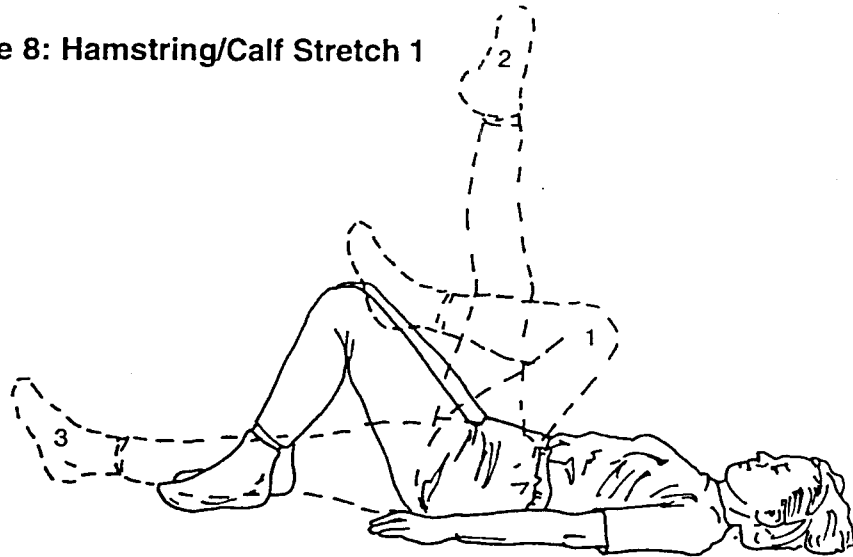
Lie on one side with your head resting comfortably on your bottom arm. Keep both knees flexed and your hips slightly flexed. Slide your top knee along the floor up toward your shoulder, then slowly extend the leg until it is completely straight, and return your knee to the bent position. The leg is dead weight. Do the exercise 3 times, then turn to your other side and repeat the exercise.

Week 2**Exercise 6: Double Knee Flex**

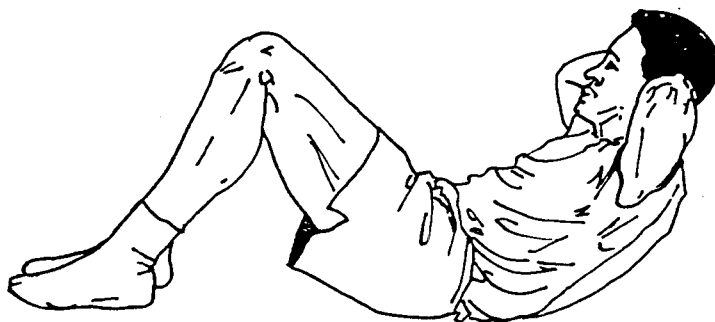
Lie on your back with both knees flexed. Raise both knees up toward your chest. Then lower your legs gradually to the floor in the flexed position. Do not raise your hips off the floor. Do the exercise 3 times.

Exercise 7: Head and Shoulders Curl Up

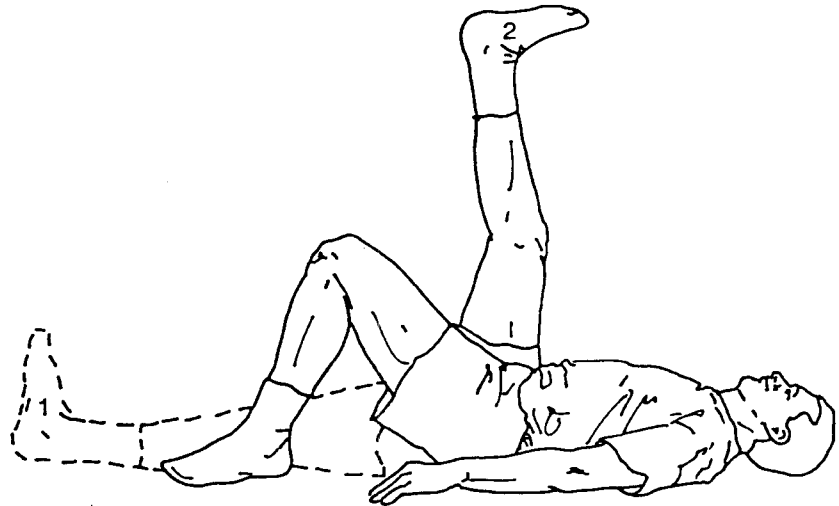
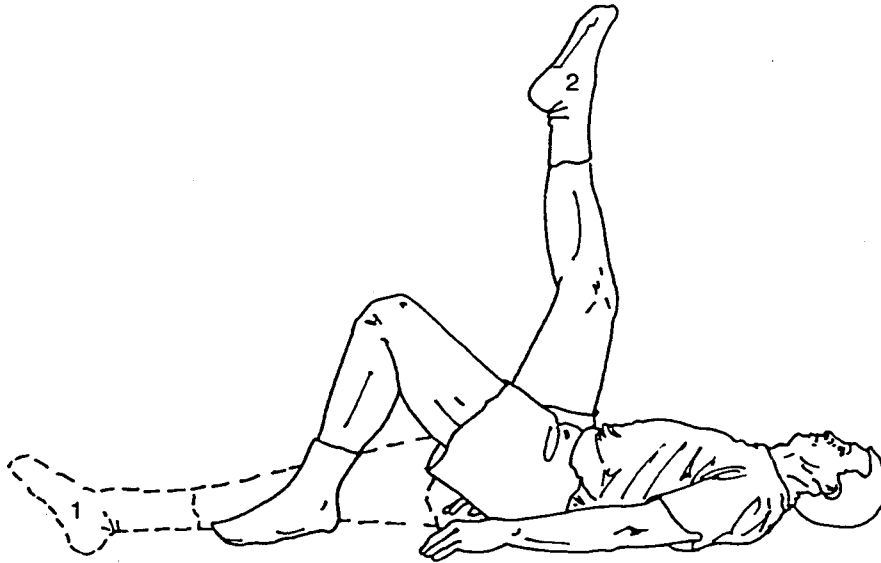
Lie on the floor with knees flexed, hands resting on your thighs. Take a deep breath and raise your head and shoulders off the floor in a curling motion, sliding your fingertips toward your knees, exhaling as you come up. Lower down slowly, and let go. Do the exercise 3 times.

Week 3**Exercise 8: Hamstring/Calf Stretch 1**

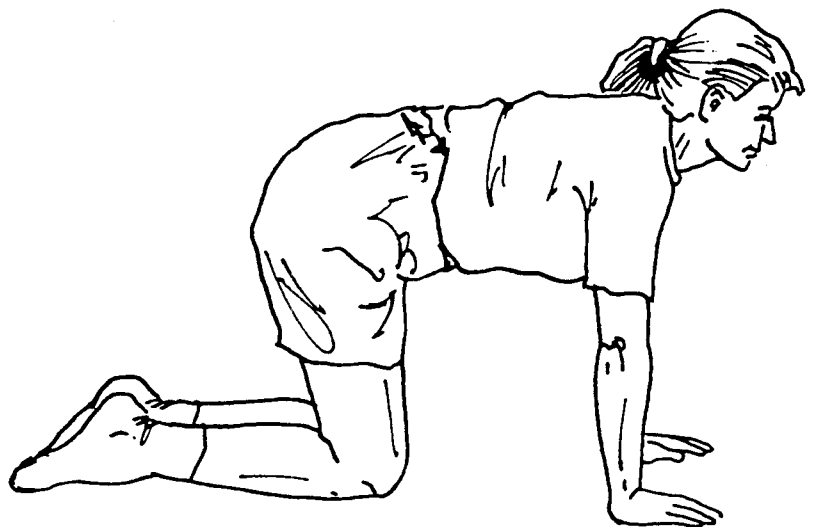
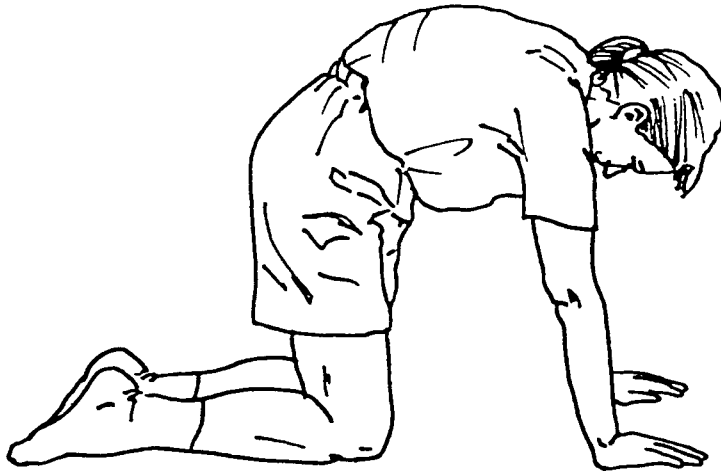
Lie on your back with both knees flexed, arms at sides. Bring one knee up toward your chest, then extend your leg, pointing your toes toward the ceiling. Keep your knees straight, holding for 5 seconds. Lower the straight leg to the floor. Then slide the leg back to the bent position. Do the same for the other leg. Then bring the first knee toward the chest, flex the foot, extend the leg, and hold. Lower the straight leg to the floor, and slide the leg to the bent position. Do the same for the other leg. Repeat the entire sequence once more.

Exercise 9: Half Sit-Up

Lie on your back with your hands at the sides of your head, knees flexed. Take a deep breath, and slowly curl up to a half-sitting position, exhaling as you do. Lower yourself slowly to a lying position. You should sit up gradually, starting by raising your head, then your shoulders, and then your upper back. Keep your lower back on the mat. If you cannot do this exercise with your hands on your head, try to do it with your hands on your thighs. Do the exercise 3 times.

Week 4**Exercise 10: Hamstring/Calf Stretch 2**

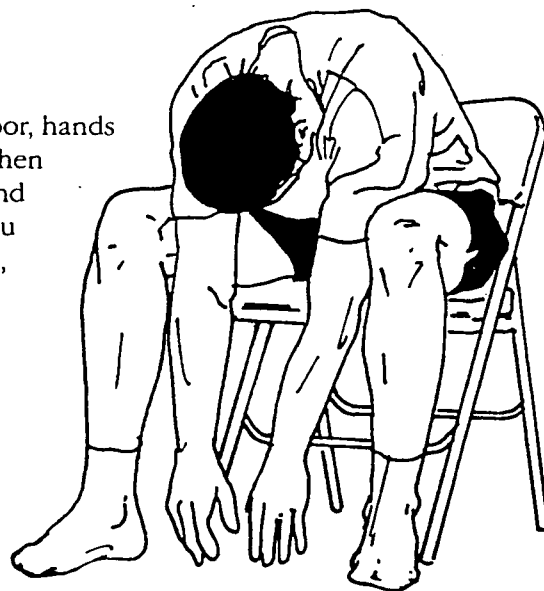
Lying on your back with knees flexed, slide one leg out, pointing the toes away from the head. Raise your straight leg as high as you can without bending it, and hold. Lower your straight leg to the floor and slide the leg back to the bent position. Do the same for the other leg. Then slide the first leg out, flex the foot, and raise the straight leg as high as you can. Hold for 5 seconds. Return the straight leg to the floor and slide it back to the bent position. Repeat with the other leg. Repeat the entire sequence one more time.

Exercise 11: Cat Back

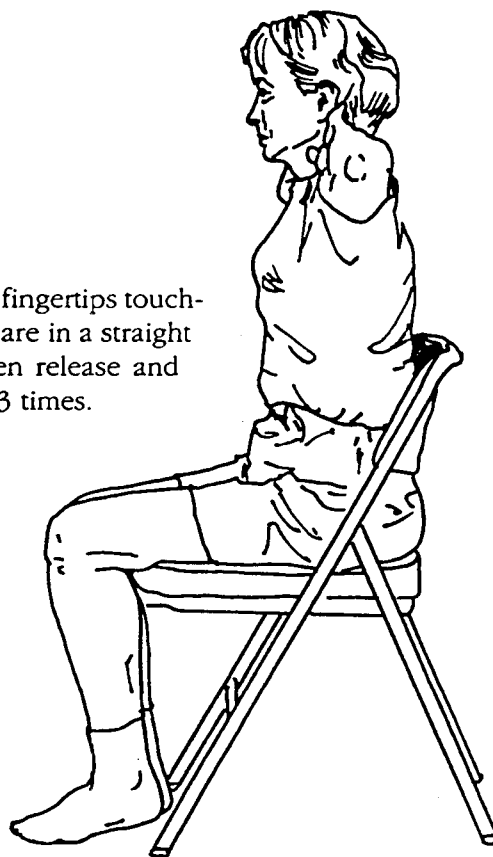
Assume a kneeling position, resting on your hands and knees. Arch your back up like a cat, lowering your head at the same time. Then let go, lowering your back and raising your head, returning to a flat back position. Do the exercise 3 times.

Week 5**Exercise 12: Forward Bend Sitting**

Sit on a chair, feet apart and flat on the floor, hands resting on thighs. Let your neck droop, then drop your shoulders and arms, and bend down between your knees, as far as you can. Slowly return to an upright position, and let go. Do not force the downward bend. Do the exercise 3 times.

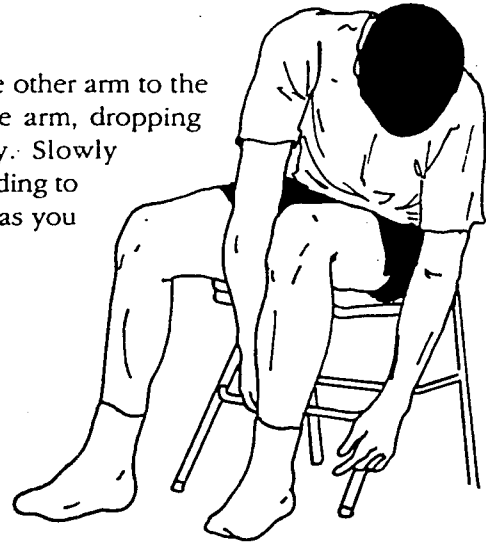
**Exercise 13: Pectoral Stretch Sitting**

Sit straight in a chair, hands behind the neck, fingertips touching. Slowly press the elbows back until they are in a straight line with the head. Hold for 5 seconds, then release and drop the arms to the sides. Do the exercise 3 times.



Week 6**Exercise 14: Side Bend Sitting**

Sit on a chair, one arm between the legs, the other arm to the side. Bend down to the side of the outside arm, dropping your head and shoulders. Hang loosely. Slowly straighten up and do the exercise again, bending to the other side. Keep your legs slightly apart as you bend to the sides. Do the exercise 3 times.

**Exercise 15: Forward Bend Standing**

Stand with feet shoulder-width apart, knees slightly bent. Limber your legs by shaking them loose. Drop your neck gradually and let your trunk "hang" loosely from your hips. Drop your shoulders and then your back gradually. Let gravity help you. Completely relax, "hanging from the hips," reaching toward the floor with your fingertips. Slowly straighten the knees, hold for 5 seconds, then release. Raise up, bending the knees. Repeat 2 more times. Limber your legs after the third repetition.



Exercise Log

On the next page is a sample exercise log for the Y's Way to a Healthy Back exercises. It covers all 6 weeks of the program. Copy this or a similar log and hand it out to class participants so they can keep track of their exercise sessions.

Y's Way to a Healthy Back Daily Exercise Log

This daily exercise routine can help you maintain a healthy back, avoid back injuries, and relieve back problems. Use this daily log to help you keep track of your progress on the road to a healthier back.

EXERCISE	Week 1							Week 2							Week 3							Week 4							Week 5							Week 6						
	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S							
1. Leg Slide																																										
2. Shoulder Shrug																																										
3. Head Roll																																										
4. Knee Lift																																										
5. Side Leg Slide																																										
6. Double Knee Flex																																										
7. Head and Shoulder Curl Up																																										
8. Hamstring/Calf Stretch 1																																										
9. Half Sit-Up																																										
10. Hamstring/Calf Stretch 2																																										
11. Cat Back																																										
12. Forward Bend Sitting																																										
13. Pectoral Stretch Sitting																																										
14. Side Bend Sitting																																										
15. Forward Bend Standing																																										

SAMPLE ERGONOMIC PROGRAM

Introduction

This is a sample ergonomics program and can be modified for a specific fire or emergency medical services department.

Purpose and Summary

The purpose of this ergonomic management program is to define lines of responsibilities and a set of guidelines that can integrate ergonomic control procedures into all aspects of the department. The goal of this procedure is to help in eliminating injuries associated with repetitive motion and manual material handling. This procedure will also provide direction toward meeting any applicable regulatory health and safety standards related to the fire and emergency medical services department ergonomics issues.

Summary

The major occupational risk factors for Cumulative Trauma Disorders (CTD) include repetitiveness, force, posture, and the use of certain types of hand tools. These risk factors should be addressed as part of the total work environment that will include workplace and tool design, lighting, temperature, the nature of the tasks, and the way the fire fighter or emergency medical technician (EMT) performs their assigned work.

Upper extremity cumulative trauma disorders are disorders caused or aggravated by repeated exertion. Consequently, CTDs are often called repetitive motion disorders. Occupationally related CTDs affect the muscle and skeletal systems or the nerves in the extremities. The upper extremities include the fingers, hands, wrists, forearms, elbows, arms, and shoulders. Injuries of the upper extremities can be classified as acute or chronic. Acute injuries usually occur suddenly during a single event or an accident. Chronic injuries usually develop slowly over a period and may involve many events. Usually, CTDs of the upper extremities are chronic injuries.

Fire fighters and emergency medical technicians will be subject to other ergonomic hazards, including heat stress, cold stress, noise stress, and visual stress. These hazards can also contribute to personnel injuries and make emergency operations difficult. Special personal protective equipment (PPE) or other equipment is often needed to limit exposure to these hazards.

This ergonomics program addresses workplace injuries, increases awareness among all personnel, and provides the appropriate management training. Ergonomics awareness among all levels of the department must be established to perform the appropriate activities such as: station planning and design; response tactics and safety, injury cost tracking and control; equipment and tool selection and purchasing; and training.

Definitions

1. ***Anthropometric*** - This is the study of people in terms of their physical dimensions. It includes the methods of measuring human body size and form.
2. ***Biomechanics*** - The application of mechanical principles, such as levers and forces, to the analysis of body part structure, and movement that includes studies of range, strength, endurance, speed of movement, and mechanical response to such physical forces as acceleration and vibration.
3. ***Cumulative Trauma Disorders (CTDs)*** - Normally, CTDs are associated with repeated or sustained activities that expose tissues to mechanical or overexertion stress.
4. ***Dynamic Work*** - Dynamic work is the opposite of static work. In dynamic work, the muscles are always changing position. They are continually contracting and relaxing.
5. ***Ergonomics*** - A multidisciplinary science dealing with the interactions between people and the total work environment to achieve optimum adjustment with the goal of reducing unnecessary physiological and psychological stress and the resultant strain.
6. ***Ergonomic Exposure*** - A workplace condition that poses a biomechanical stress or stressors on workers. Workplace conditions include, but are not limited to, faulty workstation layouts; improper work methods; improper tools; tool vibration; and job design concerns that include aspects of work flow, line speed, posture and force required, work/rest regiment, and a repetition rate.
7. ***Ergonomic Risk Factors*** - Conditions of a job, process, or operations that contribute to the risk of developing CTDs are major factors to consider. Examples include repetitiveness of activity force required, and awkwardness of posture. Risk factors are regarded as synergistic effects of ergonomic stressors that must be considered because of their combined effect in developing CTDs. Jobs, operations or workstations that have multiple risk factors will have a higher probability of causing CTDs, depending on the relative degree of severity of each factor.
8. ***Posture*** - Posture relates to the relative position of the body or body part compared to some standard or reference position (orientation).
9. ***Static Work Posture*** - Muscle contraction without motion; also, known as isometric work. (Standing is an example of static postural work; gripping or holding is an example of static manual work.)
10. ***Work Equipment*** - Tools, machines, devices, installations, and other components used in the work environment.
11. ***Work Environment*** - The work environment is constituted by people and operating equipment acting together in a work process, at the workplace in the work environment

under the conditions imposed by the work task. It must be designed to perform a particular work task safely.

12. **Workplace** - An area allocated to a person in the work environment.
13. **Work Practice** - The sequence of time and space of the interaction of people, work equipment, materials energy, and information within a work environment.
14. **Work Stress (External Load)** - The external conditions and equipments affecting people in the work environment.

Application and Responsibilities

The following section of the program outlines the application requirements of the ergonomic procedure for the following functional responsibilities:

- Department Chief and Other Senior Management/Administration
- Safety Officer and Safety Division (not all departments will have a safety unit)
- Medical Provider
- Ergonomic Committee (or safety division or other dedicated safety unit)
- Purchasing Department or Committee

Senior Management/Administration

Implementing an effective ergonomics program requires top management support and visible involvement at all levels of management, so that all personnel fully understand that management has a serious commitment to the program.

Senior management will be responsible for assigning personnel as ergonomic coordinators and for participating on the ergonomic committee. Management within respective companies or at the station level (line-supervisors) will also be required to ensure that compliance with this procedure is carried out by all employees under their direct supervision. All levels of senior management will be responsible for carrying out the following segments for the ergonomics program:

- Ensure that this policy is implemented and that management's commitment is maintained at all levels of the department.
- Communicate the responsibilities of this policy so that all supervisors and personnel know what is expected.
- Periodically review the program to determine if it is achieving the desired results and is effective.

Safety Officer and Safety Department (or other designated individual or unit)

The safety officer and the safety department is responsible for issuing ergonomic management guidelines to help in achieving ergonomic evaluations; doing regular program reviews; coordinating ergonomic training programs; coordinating they ergonomic committee; overseeing medical management systems; and tracking injury loss trends.

The safety department is responsible for managing the program on a daily basis and ensuring that all segments of the procedure are being followed. Specific responsibilities of Safety may include the following ergonomic program activities and functions:

- Coordinate implementation of the ergonomic program with Senior Management.
- Coordinate with the purchasing department and conduct and arrange for outside ergonomic evaluations of new equipment or workstations identified as having possible ergonomic exposure or other risk factors.
- Coordinate applicable training programs on ergonomics for supervisors and other personnel.
- Coordinate the ergonomics committee and monitor the effectiveness of ergonomic activities.
- Develop and administer an ergonomic monitoring program that will track the status of recommended ergonomically-based department improvements.
- Implement a proactive program to address adverse injury trends, personnel complaints related to ergonomic risk factors, and recognition of an effective workplace ergonomic change instituted.

The ergonomic program should be considered part of the department's overall occupational safety and health program which meets the requirements of NFPA 1500, *Standard on Fire Department Occupational Safety and Health Program*.

Medical Provider

The medical provider (when involved) is responsible for developing and administering a medical management system for the prevention and treatment of cumulative trauma disorders and musculoskeletal injuries related to manual material handling. This program will include the following medical management program elements:

- The medical provider, with other members of the ergonomic committee, will develop a group of jobs that will offer the least ergonomic risk. This group of jobs will be help the medical provider in recommending assignments to light duty or restricted duty jobs as applicable. In addition, they will help personnel rehabilitate and return to their normal work activities when possible.

- Within the safety department, organize a system to track and measure the extent of symptoms of work disorders for each work task. The purpose of this measurement system is to determine which jobs are exhibiting concerns and to aid in measuring the progress of the ergonomic program.
- Maintain a list of qualified health care providers who have occupational medicine backgrounds and are knowledgeable about fire fighting and emergency medical operations.
- Conduct baseline and follow-on medical examinations or coordinate these examinations with other health care providers.
- Oversee the physical training program for personnel.
- Provide or refer treatment and follow-up procedures appropriate to the injury along with screening and assessments for possible cases of CTD injuries.
- Maintain contact with outside physicians to discuss early return to work options as related to CTD.
- Establish procedures related to avoidance of heat, cold, noise, and visual stress by providing input to the selection process of PPE and other equipment.

Ergonomic Committee

The responsibility of the Ergonomic Committee will be to foster communication on ergonomic concerns and assist with the implementation of the ergonomic program.

Departments are structured uniquely, so it is up to top management to identify the key members of an ergonomics committee. The committee should consist of a carefully selected group of personnel who represent different functions in the department. The committee will be responsible for periodically evaluating the work place and work practices to identify areas that may contribute to musculoskeletal injuries.

Safety officers and safety department personnel must understand and continue to learn techniques for problem identification, training methods, and injury analysis. Managers and supervisors must be trained to interface with line personnel and to recognize potential ergonomic hazards.

If committee members have a special interest in the reduction of CTDs, they will be more committed to address CTD problems in more detail. To be more effective, the ergonomic committee must include representatives from the following groups:

- Department administration: responsible for safety; and providing resources, direction, credibility, and accountability.
- Line Personnel: understand special worker concerns; can communicate with other employees to enlist their acceptance and support of the program.

- Line Supervision: have a special understanding of task demands and the human elements required to get the job done.
- Engineering and supply: familiar with department equipment and tools
- Safety and medical providers: understanding physical and psychological stresses to the body that can result in CTDs.

The direct functions and activities of the committee are as follows:

- Members of the committee will be representatives from each department administration administration, line personnel, line supervision, engineering/supply, safety/medical providers, and other departments deemed appropriate.
- The safety department will be responsible for coordinating meetings and ensuring that all applicable business segments are represented.
- The committee will appoint a representative to act as the chairperson on a rotating basis with a time schedule established are represented.
- The committee will be responsible for addressing ergonomic issues such as: training, communication, and regulatory compliance,
- The committee will be required to collect information relative to the workplace ergonomic changes instituted and document these changes in a collective data source.
- The committee will periodically review the effectiveness of the program, at least every 3 years.

Training

Committee members must receive the appropriate training to be effective at recognizing and controlling other ergonomic risk factors. If a control program is to be successful, training cannot be limited to the committee members program must be development to include the following:

- Risk factors
- Means of prevention
- Detection of early symptoms
- Importance of reporting symptoms early
- Appropriate work practices.

Personnel with the appropriate training are more likely to be active in controlling CTDs in the workplace.

Job Hazard Analysis

A Job Hazard Analysis (JHA) provides a structured method for identifying potential injuries. The main purpose of a JHA in ergonomics is to identify activities contributing to CTDs and other ergonomic disorders. Data from injury records, medical reports, insurance records, workers' compensation reports, and the OSHA 200 logs (if used) should be analyzed. Indicators such as soreness; pain; strain; or edema of the hand, wrist, elbow, arm, and shoulder may signal possible problems.

Repetitiveness is a known factor. However, the exact number of repetitions in a given time that contribute to CTD is unknown and it will not be the same for each person. Calculation of the repetitiveness of cycle time provides another means for comparing jobs to determine which tasks present greater risks to employees. Jobs with a higher number of repetitions most frequently indicate higher risk.

The next step in analyzing a job is assessing the particular body parts used to perform the task. Review each element and anatomical part for:

- Posture
- Force
- Pressure
- Vibration
- Temperature.

Abnormal posture of any body part in doing the particular task can be a CTD risk. The goal is to maintain body parts in as near a neutral position as possible. Any type of stress, whether created by surface edges rubbing the skin or tool handles pressing into the palm or vibration, has the potential to contribute to CTDs. Vibration can be caused by hand tools or transmitted by motors located under work surfaces. Personnel who work in cold environments, use chemicals that lower the skin temperature, or work with hands exposed to exhaust from tools may also be at risk for CTD. Any job having one or more of these risk factors should be addressed. The following options should be considered for each job element having risk factors:

- Eliminate the task or element if possible
- Redesign the task so that it has satisfactory ergonomic characteristics
- Retrain the worker to complete the task in a way that eliminates the risk
- Provide appropriate PPE or other equipment
- Rotate personnel.

Videotaping personnel during responses or other jobs provides an excellent mechanism for

supervision, allocation of space, time allocation, and incentives.

Another component of the CTD control program is the management of restricted personnel. Communication between the treating physicians and the workplace task force is vital. They may be able to play a role in specifying any appropriate restrictions. Restricted personnel should be placed in jobs that do not include repetitive motions or abnormal positions. A listing of light duty jobs in each department should be developed by the ergonomic committee with department supervisors. This listing should be shared with the treating physicians. In addition, a periodic review of work restrictions is necessary to manage personnel properly. Educating all personnel involved with restricted employees will help ensure success.

Evaluations of Program Effectiveness

To be effective, an ergonomic program must be constantly evaluated and updated as necessary. One form of evaluation is to compare the CTD incidence rate after implementing the control program with the rate for the year before the program. A more sophisticated evaluation technique is to conduct a cost/benefit analysis, particularly at some point after the program has been implemented. Early attention is being given to the problem, which may result in increased identification of CTDs. Constant monitoring is necessary to ensure that personnel with CTDs are not removed from their jobs and placed into other jobs that have the same risk factors.

Tool Design

Tools used during response operations and at the station must be well-suited for the personnel and required tasks. For hand tools, the design should allow for:

- neutral wrist posture,
- reduce vibration transmissions to the hand and upper extremities,
- provide the proposed mechanical advantages, and
- possess other characteristics to intended reduce individual injury potential.

Factors, such as the amount of bend in a handle and reach (extension) are highly task specific. Optimal tool design characteristics can only be determined because of data developed at the workplace or in a laboratory evaluation that simulates task requirements.

This quantitative assessment allows for the proper identification of specific tools that produce cumulative wrist injuries and provides essential data for developing alternative work methods and tool designs to reduce injuries.

The object is to make the tool fit the fire fighter. These include weight, shape, vibration, noise, grips, switches, application pressure, and operator posture. Even more complex is the process of determining what is most ergonomically correct.

The design process begins with input from tool users and is not completed until a prototype of

evaluating body position, stress points, and repetitiveness. Slow motion and stop action will give additional advantages for evaluation. Often the actual tasks are performed in rapid motion, making direct visual observation difficult.

Videotapes showing correct work practices and incorrect methods can be useful training tool for employees. Training should be accomplished before employees begin their jobs and periodically thereafter. Practical on-the-job training with other skilled employees is often desirable until new employees become proficient in their jobs. Videotapes of tasks at the workaday can be used to gain skill in JHA and as a training tool. Such tapes will demonstrate both body movements that can lead to injury and alternative movements or positions that may reduce risk.

Once problem risk factors are identified, recommendations for change can be made. Careful planning of job changes is vital. Examples of changes can include:

- Rounding or extending handles to relieve stress on the tissues of the hand.
- Reducing vibration by using dampening materials on the body contact surfaces or replacing the tool with one designed for vibration control.
- Orienting work surfaces so that parts and materials can be positioned without requiring extreme postures of the employees.
- Eliminating unnecessary work elements.
- Structuring response efforts by rotating personnel and by provide rehabilitation on the scene of extended emergency operations.

Whenever any changes are made in the job, watch with careful attention so a new hazard is not created when you are eliminating another. All changes require a period of adjustment and evaluation.

Medical Management

Medical management is used to control and focus on early identification treatment of CTDs and other ergonomic disorders. All personnel must be encouraged to report early signs of CTDs, acute trauma, or other ergonomic disorders. A written medical management system for ergonomics must be developed. This system must be updated periodically and as necessary.

A specific health care provider should be identified which has occupational medicine experience and knowledge of fire fighting and emergency medical operations. Other physicians with specializations within occupational medical should be identified for future referrals.

The medical management system should be responsible for coordination of baseline and follow-on medical examinations. A similar responsibility should include review and coordination of regular fitness training and fitness evaluations.

The department should have a fitness training program which defines appropriate fitness training,

the new tool is put into the fire fighter's hands.

Use of PPE

PPE should be selected on the basis of human factors considerations as well as protective features. When possible PPE should be:

- as light as possible,
- not restrict fire fighter (or EMT) movement,
- be appropriate sized (and available in sufficient sizing for correct fit of department personnel and
- function as claimed by the manufacturer.

Since 'breathable' protective clothing is known to provide lower stress on individuals during light and moderate work loads, protective clothing with 'breathable' moisture barriers should be selected.

Improper footwear and lack of ankle support are major causes of ankle and lower extremity injuries. Footwear which provides good fit to the individual, especially ankle support, and having wide soles should be selected over poorly designed, inadequately designed footwear which does not provide normal fit and ankle support.

APPENDIX B

BACK SUPPORT SURVEY

To: Members of East Lake Fire & Rescue

Subject: Back Support Survey

1. Do you still consider the back brace a valuable part of your safety equipment? Y: N:
2. Do you use your brace on a routine basis? Y: N:
3. Would you like to see the brace discontinued from your equipment list? Y: N:
4. How many times in a month do you use your brace? 0: 1-5: 6-10: 11-20: >20:
5. Do you use a brace when off duty at home or other job? Y: N:

Comments:

APPENDIX C

BACK SUPPORT SURVEY RESULTS

To: Members of East Lake Fire & Rescue

Subject: Back Support Survey

1. Do you still consider the back brace a valuable part of your safety equipment? Y: 4 N:24
2. Do you use your brace on a routine basis? Y:6 N:22
3. Would you like to see the brace discontinued from your equipment list? Y:23 N:5
4. How many times in a month do you use your brace? 0:14 1-5:13 6-10:1 11-20:0 >20:0
5. Do you use a brace when off duty at home or other job? Y: 10 N: 18

Comments:

-Possible back support equipment in new Morning Pride bunker gear.

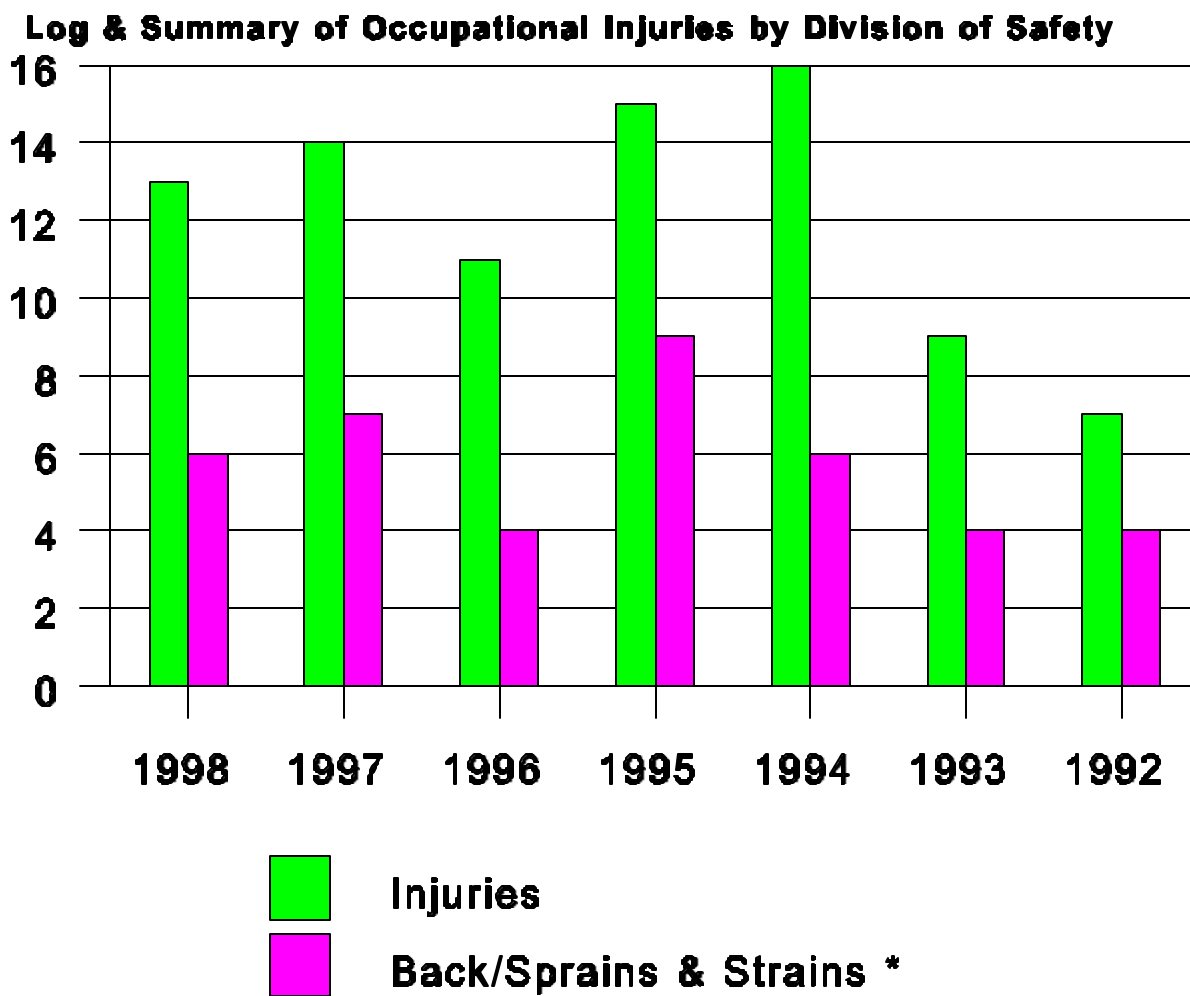
-I have never used it, however other members use it and I think we should keep it for the people who use it.

-I feel that wearing the brace will weaken the back muscles.

-When you wear the brace there is no place to put pager, radio or get access to the equipment on your belt. Need a low profile brace.

-The brace gives a false sense of security. Need to use proper lifting techniques.

1992 - 1998 INJURY SUMMARY



FLORIDA DEPARTMENT OF LABOR AND EMPLOYMENT SECURITY

*Percent of Injuries that were back/sprains & strains

1998 - 46%

1997 - 50%

1996 - 36%

1995 - 60%

1994 - 37%

1993 - 44%

1992 - 57%